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A CONSIDERATION OF THE CLINICAL AND DIDACTIC METHODS OF TEACHING MEDICINE

BEFORE undertaking to expatiate upon the main thesis of this essay, it might be well to explain briefly what is meant by the term "the teaching of medicine." Broadly speaking, what is understood by this term is the application of the science of biology, anatomy, physics and physiology, chemistry and biochemistry, pathology and bacteriology, to the study of disease as presented by the patient. It is the correlation of the sciences related to medicine, to the art of achieving a diagnosis of the morbid process from which the patient suffers and to the art of relieving the patient after the presenting symptoms and signs have been interpreted properly. Medicine as distinguished nowadays is further delineated by the adjective "internal," implying that the disease to be recognized and treated lies within the three larger cavities of the body, the cranium, thorax and abdomen, in contradistinction to some of the smaller offshoots from the main stem of medicine which are recognized as the specialties and which deal with lesions of the skin, the nerves or the special senses.

Having defined what is the usual conception of medicine in its broad sense, it should now be possible to trace the development that has taken place in the methods of teaching students in the undergraduate medical schools within the past few years. In the United States, a hundred years ago, the teaching was almost entirely individualistic. A student attached himself to a preceptor, who in theory at least was qualified to guide the neophyte through the intricacies of a medical training. On the one hand, such a method of training had the advantage of permitting the student to come into intimate contact with disease from the start of his training; on the other hand, the great bulk of the preceptors were little qualified to teach and to instruct. In the beginning of the past century such a method of training gradually was succeeded and replaced by the springing into being of more or less inadequate medical schools whose training of the student was almost entirely dogmatic and didactic and who depended for their very existence upon the fees that were collected from the students. Towards the end of the nineteenth century at Harvard, Johns Hopkins and the University of Pennsylvania, as Garrison relates, "medical teaching began to be true university teaching, in the sense of training a student to make use of his own mind as a substitute for blind acceptance of dogma." Despite these beginnings, we find that at the beginning of the present century there were hosts of medical schools of low standards, with insufficient clinical facilities, teaching almost entirely didactically large numbers of medical students. So great had been the increase in medical schools and students that we find in 1904, when the American Medical Association began its campaign to elevate the standards of medical education in the United States, that there were in existence 162 medical schools with an enrollment of 28,142 students. As a result of improved standards of medical education, the number of schools teaching medicine and fulfilling the requirements satisfactorily has fallen to 55, with a student enrollment approximately one third smaller than in the peak year, 1904. The quantitative fall in number of students has been accomplished by qualitative betterment in the type of the student body and a corresponding improvement in the medical graduate. The explanation of the better grade of practitioners now being turned out by the medical schools is that, with the decrease in number of students, greater opportunity has been afforded those in the school to study at first hand disease as it was presented by the patient. The advantages of this type of teaching, the so-called clinical teaching, are so obvious that they hardly need to be reiterated, but for the purpose of review they will be briefly enumerated.

In the first place, such a method of teaching permits the student to see and to follow up the usual run of cases as occur in the in- and out-patient department of a hospital. He is thrown into intimate contact with such types of cases as he will meet in his postgraduate work and in his practice. He learns the life cycle of disease at first hand and he learns how to diagnose and treat the disease from personal observation of the patient. The unusual, abstruse and difficult cases are not picked out for him to study and are not accentuated as they were in the old days when the teacher would select such cases for the purpose of delivering a brilliant lecture. On the contrary, he sees patients as they come into a service and only occasionally meets a case of some exotic disease. Secondly, the protagonists of clinical teaching maintain that the time spent in lectures is time wasted. Much better would it be were the student to employ the lecture hour in reading or in the objective study of a patient than, parrot-like, to copy the words of one who has prepared his lecture largely from a text-book. On the other hand, in a clinical talk with the patient before him, in contradistinction to the formal lecture, the teacher is enabled from a concrete example to enter into a full discussion of the disease as presented by that patient, as seen by him in other patients and as studied in various phases and in minute detail by investigators throughout the world.

Another advantage of clinical teaching lies in the fact that it is more thorough. It is an inherent characteristic of the great body of mankind that they are better able to remember what they have seen than what they have heard. And this faculty of remembering is greatly enhanced because the student is given the opportunity of not briefly seeing the case, passing in review as it were, but of actually spending hours and even days studying the various manifestations of the disease.

Lastly, and probably more important than all the other advantages of clinical teaching, is the training it gives the student in the use of his eyes and his ears and his sense of touch. He learns to use his senses, to make proper deductions from what he has observed and then he learns to cultivate his mind; he learns the art of reasoning and he trains himself, he becomes experienced—factors which are of prime importance in learning any science.

All these statements are well recognized. The increase in the length of the curriculum that has come about in the past thirty years is merely recognition of the fact that a student must dissect, must use his microscope, must titrate his specimens and must work on the patient. The increased hours the student spends in his learning of medicine are not devoted to new subjects as much as they are given over to the individual doing and seeing, deducting and reasoning, rather than merely hearing and copying.

But the question comes up: Are we not allowing the student to spend too much time in practice and are not his efforts, particularly in internal medicine, likely to be too unsystematic? Didactic teaching has many advantages, in spite of the fact that the pendulum has swung far away from it and that in many universities in the teaching of medicine it has been done away with almost entirely. Among the advantages that it presents, when used in moderation, is that it affords opportunity for the arrangement of a systematic course in medicine. One disease after another can be taken up in a definite and fixed order and the clinical teaching can be so correlated with the didactic that greater interest is aroused in the student when he sees what he has been recently told than when he is thrown precipitately into the study of a new case. The reading of the student can also be better correlated than when he is presumed to be following a course of reading and studying without definite guidance. This is supposedly obviated by conducting classes and quizzes in some systematic manner, but such a method of teaching is only a variation and not a difference in didacticism. Unless there is some such definite guide, practically a student does not follow any comprehensive plan in his studying.

From the pedagogic standpoint, we may assume that the clinical or practical method of teaching is the ideal, but from the point of view of a practical educator there is always before the student various examinations which he will have to take after he has left the medical school and before he becomes a qualified physician. It is all right to say that, if a student learns to study one type of case thoroughly and properly, when he sees an unusual type of case which he has never seen in his student days (and no hospital can show in two years every type of disease and disorder), he will be able to study this new case in a suitable and proper manner. But hospital examining boards and state boards do not know this nor do they know what diseases a student has seen or has not seen. Therefore it behooves the student, if he is to pass examining boards not connected with his university, to learn more or less about every disease and it behooves the instructor so to teach the student. Much as the necessity of this is to be regretted, it is not a theory and must be faced. A medical school must not only train the mind and the intellect of its students, but it must also give them such instruction as will permit of their being allowed by state authorities to exercise their presumably well-trained abilities.

Lastly, one of the very real advantages of a course of didactic lectures lies in the inherent value of the first-hand opinions and ideas which the head of a department is enabled to give his teachers and his students. In no other way is the man who is presumed to be best acquainted with the theory and practice of medicine able to get together as one group all those associated with him and to tell them what he feels and thinks and knows about disease and so to correlate the teaching in his department that it may be a cohesive whole. The leader should lead. This he can not do, at least in purely physical teaching, even if we presume that he has great abilities as an executive, as a stimulator of research or as a leader of men, if his energies are devoted only to such small groups of men that many in the class never have the opportunity of seeing his methods or attaining his point of view.

The objections to and disadvantages attributed to didacticism are numerous, but the chief criticism of those who believe in the clinical methods of teaching is that it abolishes or at least minimizes the advantages inherent in this, the clinical, method of instruction. By this rather paradoxical statement I mean to imply that education, without training of the student's mind to deduce facts from observations, without allowing for the development of his initiative and without giving him opportunity of developing his reasoning power, is in no sense real education and that without these attributes a man may mimic a medical education but he is not an educated, trained physician. Minor points of attack in the didactic method of teaching include waste of time to the head of a department and to the student. In the case of the first individual it is said that the preparation and delivery of a lecture is time-consuming without compensatory advantages. The hour that is spent in delivering a lecture is preceded by many long hours of preparation, for a good lecture is not a spontaneous outburst of oratory, but a prepared, systematic marshalling of facts, from personal knowledge, from text-books and from current medical literature in an orderly fashion so that the whole subject is discussed *in toto* thoroughly. For the second individual, the student, the waste of his time lies in the knowledge that the greater part of what is said in the lecture can be read in a text-book, and read repeatedly in a time equivalent to that devoted to listening to a lecture.

To those who hold that a certain number of didactic lectures are necessary in teaching internal medicine, certain basic faults of clinical teaching present themselves. The lack of system is the first. It has been discussed sufficiently. Another difficulty is that a large amount of clinical material is necessary to give the student opportunity of studying many cases and such material is not always available without very extensive hospital facilities. More teachers are required, because a group of students can not be turned loose in a ward or clinic without the guidance of some one properly qualified to aid them. The need of much material and a large number of instructors is a very real difficulty to those schools which are not heavily endowed and whose budgetary troubles are ever-present. Lastly, it frequently happens that to one student there may be assigned in his two years of practical work a series of patients who present almost identical diseases. One man may have the misfortune to see only heart cases; another, patients with metabolic disturbances only, while a third may have the ill luck to work with a group of unusual cases which he will rarely if ever see in his subsequent career. Nor can this difficulty be avoided. Because of the need of a large number of patients it is impossible for one man to assign to the students each case and to keep track of those diseases which have been assigned to each man. The assignments are made by many men. Furthermore, it is usually the custom to have the patients assigned to a student in rotation as they enter the ward or clinic, disregarding the relationship of the type of case to the need of the student.

In summarizing the arguments, pro and con, of the several methods of teaching medicine, it is hoped that the reader will appreciate that there is no desire on the part of the writer to quarrel with the protagonists of either form of teaching. Purely didactic, dogmatic methods of teaching have been so completely eliminated from the curriculum of medical schools that such methods will probably never be resurrected. The disadvantages of such a type of teaching are so obvious that no one ever considers nowadays the possibility of relapsing into the scheme of teaching employed thirty and more years ago. There does seem, however, room for the scheduled didactic lecture on the roster of the medical student and it should not be abolished without due thought simply because it is the pedagogic style to do away with it. The ideal arrangement would appear to be a major portion of the student's time devoted to clinical study of his patients combined with a minor portion of the time devoted to didactic lectures in which the head of the medical department could dwell upon the broad and fundamental principles of medicine and at the same time present his subject in a systematic, orderly fashion.

J. H. MUSSER

TULANE UNIVERSITY OF LOUISIANA

ON CYTOMORPHOSIS IN BACTERIA[1]

BACTERIOLOGISTS have been divided in opinion regarding variations in the morphological characters of bacteria. The most generally accepted teaching has been that these characters are invariable except for such pathological changes as may be brought about by an unfavorable environment. But a not inconsiderable minority have maintained that bacteria exhibit a complex "life cycle" similar to that of protozoa or higher fungi, the various stages of which may be found only in varying media. This view has been most elaborately presented in the recent monograph of Löhnis.[2] That the first theory is untenable must be apparent to any one who will patiently apply his eye to the microscope; on the other hand most bacteriologists are not inclined to accept as proven that bacteria show sexual reproduction, alternations of generation, or in general such a complex structure as is implied in the term "life cycle."

I believe that the error in both of these teachings is due to insufficient consideration of the element of time. The first school has been satisfied with its standardized observation of a twenty-four hour culture; the second has tried to patch together a complete picture from isolated observations on widely differing media, both favorable and unfavorable to growth, generally without regard to the phase of growth of the culture. If we are to understand clearly the life cycle of an organism we must observe consecutively all stages in its development. This we may do, with bacteria, either by continuous observation of the growing organisms in the agar hanging block or by removing samples from a growing culture at frequent intervals. The former method yields only a limited amount of information, for after a few cell divisions the cells become so numerous and closely packed together that nothing can be clearly seen. The latter procedure, involving the construction of a picture of the whole from samples, requires the use of statistical methods.

I have been carrying on such quantitative studies of the morphological characters of several species of bacteria and have arrived at a theory different from either of those mentioned. It is, briefly, that the cells of bacteria undergo a regular metamorphosis during the growth of a culture similar to the metamorphosis exhibited by the cells of a multicellular organism during its development, each species presenting three types of cells, a young form, an adult form and a senescent form; and that these variations are dependent on the metabolic rate, as Child[3] has found them to be in multicellular organisms, the change from one type to another occurring at the points of inflection in the growth curve. The young or embryonic type is maintained during the period of accelerating growth, the adult form appears with the phase of negative acceleration, and the senescent cells develop at the beginning of the death phase. Minot[4] has coined the word "cytomorphosis" to designate such progressive changes in the cells of multicellular organisms, and I believe that this term more clearly expresses the real nature of the morphological variations in bacteria than does "life cycle."

This idea is not entirely new. It has been implied in much of the bacteriological literature, but as far as

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[1] From the Department of Bacteriology and Immunology, University of Minnesota, Minneapolis, Minnesota. Read before the Society of American Bacteriologists, Washington, D. C., December 30, 1924.

[2] Löhnis, F., "Memoirs of the National Academy of Sciences," Vol. XVI, 1921.

[3] Child, C. M., "Individuality in Organisms." Univ. of Chicago Press, Chicago, 1915.

[4] Minot, C. S., "Modern Problems of Biology." P. Blakiston's Son, Philadelphia, 1913.

I know has not been explicitly stated before. Thus the term "involution form" implies changes associated with senescence and death, and we have long known that motility is usually present only in young cultures and that spores are formed in older ones. But the observation that there is a distinct difference between the cells of young cultures and older ones in practically all species of bacteria has been made only relatively recently by Clark and Ruehl,[5] who have shown that, excepting members of the diphtheria group, the young cells are considerably larger than the older ones. They failed, however, to realize the significance of this phenomenon, for they believed that the increase in size is merely that due to enlargement of the cells preparatory to cell division. If this were the case the maximum size attained would be only twice that of the cells in the original inoculum; or more likely, since in any sample there would probably be just as many recently divided cells as cells just about to divide, the average maximum would be only one and a half times as great as the average size of the resting cells. But I have found in observing developing micro-colonies of Bacillus megatherium that the cells progressively enlarge, reaching a greater size previous to each succeeding cell division, and in measuring samples from a growing culture that the maximum size attained may be as much as six times that of the resting cells. Moreover, the increase in size is accompanied by other changes in morphology; intracellular granules disappear, the protoplasm becomes more hyaline and stains more deeply. And these changes in cell structure are accompanied by physiological variations, for Sherman and Albus[6] have found that such young cultures are more susceptible to harmful agents than are older ones; a condition which also finds its parallel in multicellular organisms, as Child[7] has shown that here also the susceptibility to poisons varies with the metabolic rate.

We may look upon these large cells, then, as a definite morphologic type, the embryonic form, so to speak, characteristic of the stage of active growth. Parallel measurements of cells and cell counts show that the change in size is definitely correlated with the rate of growth.[8] The increase in size commences during the latter part of the lag phase, progresses rapidly during the phase of positive acceleration, reaches its maximum at the moment of most rapid growth, and decrease occurs rapidly during the stage of negative acceleration. This has been repeatedly found true for Bacillus megatherium and in a single observation also for Bacterium coli. The increase involves all dimensions, but the increase in length is proportionately greater than the increase in breadth, so that the larger cells are relatively more slender, the area-length index becoming smaller as the length increases.[9]

If some of the cells be transferred to fresh medium during the period of increasing size they continue to increase in size and will reach a higher maximum than those remaining in the parent culture; if transferred at the period when they have just returned to the original size they immediately begin to increase again; but if transferred a little later, they show an appreciable lag in the new medium.[10] This exactly parallels the results of measurements of the rate of cell divisions when seedings of different age are used; and is also similar to the phenomena observed in tissue cultures, where the cells tend to mature or differentiate if allowed to remain in the same plasma, but revert to the embryonic type if a small portion is transferred to fresh plasma.

If a series of media of the same volume and composition are inoculated with varying numbers of bacteria they will all come to the same level of growth, earlier and more rapidly with the larger seedings. The stage of positive acceleration in growth is therefore more prolonged with smaller inoculums, and it is found that the fewer the cells introduced, the longer is the period of increase in size and the greater the maximum size attained.[11] I have found that, by varying the concentration of the nutrient in the medium, within certain limits (probably determined by the sensitivity of the organism to osmotic pressures) the final level of growth is proportional to the concentration of the nutrient. With the same seedings, then, the phase of negative acceleration must come progressively later with the more concentrated mediums, and it is found that the richer the medium, the longer is the period of increase in size and the greater the maximum size attained.[12]

In multicellular organisms the embryonic stage is followed by cell differentiation. It is obvious that in bacteria we have no such variation in form as is implied by this term. But with cells uniformly distributed through a nutritive medium these cells should be more uniform in structure than cells nourished by a circulatory system regulated locally by the organism as a whole. We may definitely state, however, that bacteria have a mature form distinct from the embryonic form, characterized by smaller size, granularity of the protoplasm and fainter staining. Minot says that differentiation "consists essentially in this, that something new becomes visible in the protoplasm." In this sense many species of bacteria show differentiation, for they develop spores or metachromatic granules in the mature cells.

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[5] Clark, P. F., and Ruehl, W. H., *Jour. of Bact.*, IV, 615–629, 1919.

[6] Sherman, J. M., and Albus, W. R., *Jour. of Bact.*, VIII, 127–139, 1923.

[7] Child, C. M., *loc. cit.*

[8] In an earlier paper (Henrici, A. T., Proc. Soc. Exp. Biol. and Med., XX, 179–180, 1922) I have made a statement to the contrary. This error was due to faulty technique in counting the cells.

[9] Henrici, A. T., Proc. Soc. for Exp. Biol. and Med., XXI, 215–217, 1923.

[10] Henrici, A. T., Proc. Soc. for Exp. Biol. and Med., XXI, 343–345, 1924.

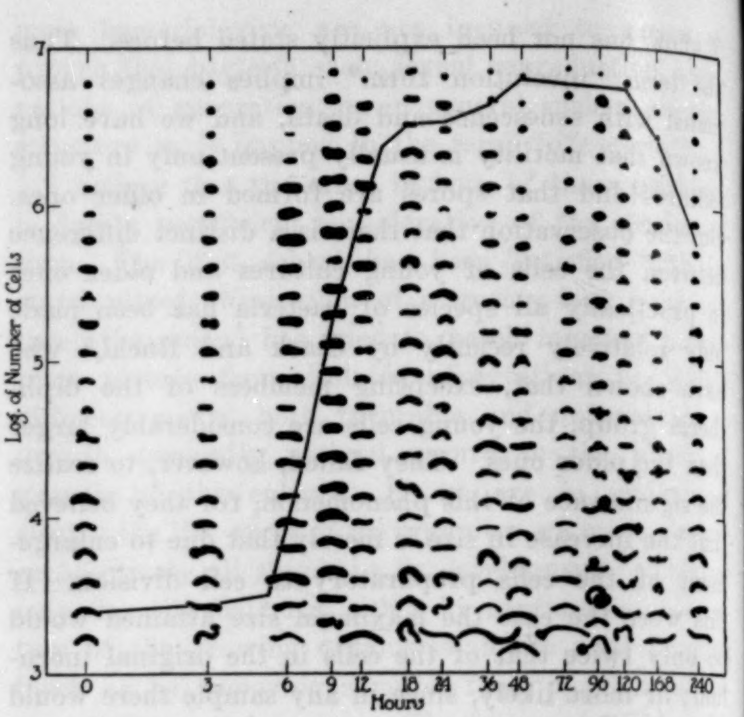
[11] Henrici, A. T., Proc. Soc. Exp. Biol. and Med., XIX, 132–133, 1921.

[12] Henrici, A. T., Proc. Soc. Exp. Biol. and Med., XXI, 345–346, 1924.

Spore formation begins when the culture has nearly reached the maximum growth, at the beginning of the so-called stationary phase. This point of inflection must also come progressively later with small seedings and with concentrated mediums, and so we find that spore formation proceeds less rapidly under these conditions than when the reverse conditions obtain.[13]

Clark and Ruehl found that the diphtheroid group differed from the other organisms studied in that the cells decreased in size during the period of active growth. This I have confirmed.[14] The cells become smaller and deeper staining and form chains; the decrease is greater in length than breadth, so that they appear almost like chains of cocci. The metachromatic granules rapidly disappear. The minimum size, however, is attained not at the mid point of the growth curve, but nearly at the end of growth. The metachromatic granules reappear more rapidly than the cells increase in size. This group will require further study before the different types can be definitely correlated with their proper phases of growth. Unpublished observations show that both the size of the cells and the number of granules are influenced by the size of the seeding and the concentration of the medium, so that these variations are definitely dependent on the metabolic rate.

I have not studied any of the cocci. Clark and Ruehl found that this group varied in size like the bacilli, and will undoubtedly follow the same laws. The spirillum of cholera shows three distinct types of cells, as shown in the accompanying illustration. The rate of growth is shown on this graph by plotting the logarithm of the number of cells against the logarithm of time. The columns of cells represent every tenth cell from a sample of 200 examined at each time interval and arranged in the order of their area-length index. It will be observed that very little change occurred during the lag phase; that with increasingly rapid growth there appeared a group of new cells, long, plump and relatively straight; with decreasing growth the cells become more slender and curved, the typical "vibrio" form; and when growth is arrested and death begins the cells assume bizarre forms, showing bulgings and "budding" and many become spherical. It is these latter types which Löhnis and others have described as extraordinary reproductive cells; but the trend of the growth curve would indicate that this is not the case. It is noteworthy that only the mature cells are spirilla, the embryonic forms being bacilli and the senescent types cocci!



It is at first glance rather difficult to conceive of these simple variations in the cells of bacteria as being at all comparable to the complex changes which take place in the cells of a developing multicellular organism, but I believe the difference is one of degree rather than kind. There are, as far as I know, no quantitative data available whereby cell changes in a growing embryo may be definitely correlated with phases of growth; but from qualitative observation it would seem that cell differentiation must begin somewhere near the point of inflection in the fetal growth curve. Also, although various recent authors have called attention to the similarity existing between the growth curves for a population and for an individual, it is rather difficult to conceive of these processes as being similar or acted upon by the same causes. But it may well be that fundamentally there is no great difference between a population of one-celled organisms and a multicellular organism which in the last analysis is only a more closely knit together population of cells. At any rate, if the hypothesis here presented is correct, it would seem that it will eventually be possible to express cytomorphosis in quantitative terms as a function of the reaction between protoplasm and its substrate.

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[13] Henrici, A. T., Proc. Soç. Exp. Biol. and Med., XXII, 197–199, 1924.

[14] Henrici, A. T., Proc. Soc. Exp. Biol. and Med., XX, 179–180, 1922.

ARTHUR T. HENRICI

UNIVERSITY OF MINNESOTA

THREE LETTERS BEARING UPON THE CONTROVERSY OVER EVOLUTION

THE three letters appearing below have been used by the writer on a number of occasions, but only the one by President Wilson has been made available by publication.[1]

Since the campaign against evolution is spreading in certain localities and since the statements of Dr. Etheridge and Professor Bateson are widely used by anti-evolutionists in support of their doctrines, it may not be amiss to publish these letters where they will be available for use in the refutation of declarations that pass current. The letter by Wilson is included for convenience of reference and because of its general usefulness.

Washington, D. C.
29th August 1922

My dear Professor Curtis:

May it not suffice for me to say, in reply to your letter of August twenty-fifth, that of course like every other man of intelligence and education I do believe in Organic Evolution. It surprises me that at this late date such questions should be raised.

Sincerely yours,

WOODROW WILSON

Professor W. C. Curtis
Columbia, Missouri

The circumstances connected with this letter are explained in the article just cited. The following comment which was made in that connection is appropriate here:

> If the speaker is correctly informed, Mr. Bryan has recently declared from his Chautauqua platforms that he defies any son-of-an-ape to show that he (Bryan) is neither intelligent nor educated. I make no comment upon what an intelligent and educated ex-President perhaps thinks of the mental caliber of an ex-Secretary of State.

The following letter from Professor Bateson was received in response to a specific request. To the biologist, Bateson's address was, of course, sufficiently explicit, but the writer had found it unsatisfactory, in the case of one teacher who was under fire, to merely state that this distinguished zoologist meant only to question the factors of the evolutionary process.

11 December 1922
The Manor House,
Merton
London, S.W. 20

Dear Professor Curtis:

The papers you have sent me relating to the case of Mr. ——— give a curious picture of life under democracy. We may count ourselves happy if we are not all hanged like the Clerk of Chatham, with our pens and ink-horns about our necks!

I have looked through my Toronto address again. I see nothing in it which can be construed as expressing doubt as to the main fact of Evolution. In the last paragraph (copy enclosed) you will find a statement in the most explicit words I could find, giving the opinion which appears to me forced upon us by the facts—an opinion shared, I suppose, by every man of science in the world.

At Toronto I was addressing an audience, mainly professional. I took occasion to call the attention of my colleagues to the loose thinking and unproven assumptions which pass current as to the actual processes of evolution. We do know that the plants and animals, including most certainly man, have been evolved from other and very different forms of life. As to the nature of this process of evolution, we have many conjectures, but little positive knowledge. That is as much of the matter as can be made clear without special study, as you and I very well know.

The campaign against the teaching of evolution is a terrible example of the way in which truth can be perverted by the ignorant. You may use as much of this letter as you like, and I hope it may be of service.

Very truly,

W. BATESON

The paragraph to which Professor Bateson refers above is the concluding one of his address and runs as follows:

> I have put before you very frankly the considerations which have made us agnostic as to the actual mode and processes of evolution. When such confessions are made the enemies of science see their chance. If we can not declare here and now how species arose, they will obligingly offer us the solutions with which obscurantism is satisfied. Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion. The obscurantist has nothing to suggest which is worth a moment's attention. The difficulties which weigh upon the professional biologist need not trouble the layman. Our doubts are not as to the reality or truth of evolution, but as to the origin of *species*, a technical, almost domestic, problem. Any day that mystery may be solved. The discoveries of the last twenty-five years enable us for the first time to discuss these questions intelligently and on a basis of fact. That synthesis will follow on an analysis, we do not and can not doubt.

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[1] *Cf.* "Current aspects of the doctrine of organic evolution," *School and Society*, April 14, 1923.

A certain Dr. Etheridge, of the British Museum, has been widely cited by the Fundamentalists as an "eminent authority." Just who this Etheridge was and the extent to which he represents the British Museum appears from the following letter addressed to Dr. James H. Snowdon, of the Western Theological Seminary, at Pittsburgh, Pennsylvania. Dr. Snowdon had been annoyed by the citation of an "authority" for whose importance he found no one to vouch, and hence wrote to Professor Harmer. A copy of this letter was furnished the writer by Dr. Snowdon for purposes of reference or publication.

British Museum (Natural History)
Cromwell Road
London, S. W. 7
25 July, 1922

Dear Sir:

I beg to acknowledge the receipt of your letter of July 8, referring to an alleged quotation, from some work by Dr. Etheridge, on the subject of Evolution.

This quotation, or a paraphrase of it, is more or less familiar to us, and it is not long since I had to answer another enquiry on the subject from your country. I believe the Dr. Etheridge in question to have been Robert Etheridge, Junr., who was Assistant Keeper of Geology in this Museum from 1881 to 1891. The remainder of his life was spent in Australia, and he died in 1920.

A considerable list of papers by Robert Etheridge the younger is given in the ''Catalogue of the Library of the British Museum (Natural History),'' vol. II, 1904, pp. 544, 545. A diligent search in the originals might result in the discovery of the quotation, but we should not think it worth while spending much time in looking for it. I regret that I am not in a position to give you the reference. Should you ever discover it I should be obliged if you would let me know.

In one respect your quotation differs from the form in which I last met it. In its present aspect it claims to prove the falsity of the views of those who accept the theory of Evolution. It might be possible for a cautious Biologist to maintain that a theory like this is incapable of exact proof, but it would certainly be equally true that it was incapable of disproof.

Mr. Etheridge's opinion on this subject should not be considered as in any way representing scientific opinion in this Museum. While differences of opinion may exist as to the nature of the causes which have induced Evolution in animals and plants, it is generally admitted that the theory of Evolution, irrespective of the way in which it has been brought about, constitutes the groundwork which entitles Biology to be considered a Science.

I remain,
Yours very truly,
SIDNEY F. HARMER
Director.

The publication of these letters seems justifiable, because in these piping times of reaction, one may at any time be called upon to definitely refute statements by a more effective means than his personal declaration that an author could only have meant thus and so; or that an alleged authority is no great authority at all, if indeed he made any such statements.

W. C. CURTIS

UNIVERSITY OF MISSOURI

SCIENTIFIC EVENTS

THE MUSEUM OF SCIENTIFIC INSTRUMENTS AT OXFORD UNIVERSITY

THE Museum of Scientific Instruments at Oxford University was declared open by Lord Crawford on May 5. We learn from an article in the London *Times* that it is housed in the Old Ashmolean Building and is the result of the gift to the university by Mr. Lewis Evans of his remarkable collection. These instruments in Mr. Evans's collection have been obtained from many sources during more than 40 years, and the presentation of them to the university has given Oxford a new scientific museum, which is appropriately housed in the beautiful building where the first public museum of its kind was opened in 1683.

Additions to Mr. Evans's collection have been made by several other persons, and some apparatus has been loaned for exhibition by colleges, so that there are now to be seen there instruments of the exquisite workmanship of the Middle Ages together with some of much earlier date, which illustrate the history of many sciences. Specially interesting among these are the portable astrolabes and dials used by travellers to calculate the time by day or night. There are examples of these from times as early as that of St. Paul, and there are specimens of the styles in various countries and centuries down to the times of Columbus and Newton. The collection of 63 astrolabes includes many interesting exhibits, and with those already in Oxford forms the largest and most representative series in the world. The earliest astrolabe is the Persian one of Ahmad and Mahmud, dated 984, the first dated scientific instrument known. The portable dials show the work of makers in all the countries of Europe.

There are several globes of various periods, sets of mathematical instruments, survey instruments, magnets and early compasses, telescopes, microscopes and other optical instruments, and a library containing about 1,000 volumes relating to scientific instruments, astronomy and dialling, about 40 of them being in manuscript. The whole is accommodated in the building, which is believed by many to have been built from plans of Wren for the permanent home of the Royal Society in Arundel Gardens in London.

At the opening ceremony, the vice-chancellor, Mr. J. Wells, who presided, said one reason why they in Oxford were able to show so many links with the scientific past was that after the end of the seventeenth century Oxford went to sleep in relation to scientific matters and the study of science was not always actively pursued. Whereas the Royal Society scrapped their old instruments and put in new ones. Oxford had not been careful to replace its instruments. Thus Oxford was more rich in old scientific apparatus than almost any other university in the world.

THE NATIONAL MUSEUM OF ENGINEERING AND INDUSTRY

FROM the New York *Times* we learn that the plan to establish a National Museum of Engineering and Industry under the Smithsonian Institution drew together on June 18 many distinguished scientists, engineers and industrialists.

The occasion was a luncheon-meeting at the Bankers' Club of those sponsoring the movement, which was started a year or so ago to arouse interest in the project. Samuel Insull, the leading figure in the midwestern public utility field, was formally installed as president of the association for 1925–26. Incidentally it was disclosed by Thomas Ewing, who presided, that $1,000,000 has already been pledged toward the $10,000,000 fund which will be raised to pay for the erection of the building in Washington.

Mr. Insull succeeds as president Dr. Elihu Thomson, under whose incumbency the germ of the idea for an institution which will put the United States in the category of European nations having similar museums was developed. The government is expected to provide the site for the institution and it is hoped that the congress will aid in furthering and maintaining it.

H. F. J. Porter is the executive secretary of the organization charged with the task of coordinating the activities of the various professions and industries supporting the project. Vice-presidents are Drs. Edward G. Acheson, Charles F. Brush, L. H. Baekeland, Frank J. Sprague, Thomas A. Edison, Edward Weston, Orville Wright. George E. Roberts is treasurer.

The Board of Trustees include Mr. Insull as chairman; R. F. Bach, B. C. Batcheller, F. H. Colvin, James Craig, E. O. Cutler, Norman Dodge, Thomas Ewing, Colonel Michael Friedsam, Major H. A. Gillis, Henry Goldmark, F. A. Halsey, George Iles, Professor D. C. Jackson, Luis Jackson, W. W. Macon, L. C. Marburg, H. P. Merriam, W. N. Polakov, A. J. Poole, H. F. J. Porter, D. S. Simpson, Dr. Elmer A. Sperry, Professor Holland Thompson and F. A. Waldron. Honorary members are Dr. Charles W. Eliot, General George W. Goethals, Secretary of Commerce Herbert Hoover, Charles M. Schwab, Melville E. Stone and Dr. Elihu Thomson.

Many of the aforementioned were present at the meeting, as well as many prominent men not identified with the organization as members. At the head table were Samuel Rea, president of the Pennsylvania System; Elbert H. Gary, chairman of the United States Steel Corporation; Mr. Insull, head of the Middle West Utilities Company, Commonwealth Edison Company of Chicago and other utility companies; Mr. Edison, John W. Davis, Dr. Alexander C. Humphreys, president of Stevens Institute, and Mr. Ewing, the patent attorney.

Speakers were Mr. Insull, F. R. Low, president of the Society of Mechanical Engineers; Farley Osgood, president of the American Institute of Electrical Engineers, and Dr. Humphreys.

FISHERIES CONSERVATION CONFERENCE

THE Fisheries Conservation Conference of May 22, 1925, called by the Secretary of Commerce and attended by representatives of the fish commissions of the Atlantic and Gulf Coast states, was held at the Department of Commerce to consider a procedure for saving certain of our Atlantic coast fisheries from final destruction. Among the subjects discussed were the fisheries for shad, sturgeon and lobsters, and incidentally the questions of the control of fisheries in boundary waters and the destruction of undersized or immature fish.

The conference requested the Secretary of Commerce to appoint, with the approval of the governors of the states, a commission to work out the various problems leading to the rehabilitation of lobster, shad, sturgeon and other fishes of our coastal waters and agreed as to the necessity for concerted action to prevent further depletion.

The resolution adopted by the conferees follows:

WHEREAS, The necessity for concerted action by the coast states to protect national fisheries has been forcefully called to our attention by Secretary Hoover; and

WHEREAS, The secretary has seen fit to call this conference for the purpose of devising ways and means for rehabilitating these fisheries; be it

Resolved, That representatives here assembled go on record as indorsing the purpose of the conference and expressing on behalf of our various states our gratitude for Mr. Hoover's intelligent and patriotic interest in calling the conference: be it further

Resolved, That it is the desire of the representatives here assembled that the secretary shall, with the approval of the governors, appoint a commission composed of representatives from each of the fish commissions of the

Atlantic States to work out various problems relating to the lobster, shad and other anadromous fishes of our coastal waters; be it further

Resolved, That in considering means of improving fishing conditions we particularly indorse and recommend any and every action that may be taken to subserve the welfare, comfort and material success of the commercial fishermen.

THE LAKE PLACID MEETING OF THE METRIC ASSOCIATION

Near our office in New York is the statue of Marquis Lafayette, beneath which is carved, "As soon as I heard of American independence, my heart was enlisted." Thousands of American and Canadian men and women are now enlisted in the campaign to secure the advantages of the general use of the same metric weights and measures which Lafayette used. These are hereby called together to review the progress of the metric campaign and take counsel on important matters. With the help of Dr. Melvil Dewey, a pioneer of the movement in America, the Metric Association has arranged for a meeting at the Lake Placid Club, Essex County, New York, beginning at 10 A. M., on Friday, July 10, 1925, and extending to July 12. Sessions will be held on Friday and Saturday morning from 10 to 1. The remaining time will be left open for conferences and recreation.

The Lake Placid Education Foundation invites those attending to a Boston Symphony concert, a metric dinner, a 70-kilometer automobile ride through some of the famous Adirondack passes and a trip on the lake. Among the speakers expected are George F. Kunz, Harvey W. Wiley, Eugene C. Bingham, Arthur E. Kennelly, Theodore H. Miller, Frank Crane, Irving Fisher, Henry D. Hubbard, F. J. Schlink, W. P. Wilson and Aubrey Drury. We hope also to hear from several of the ladies who are to attend.

One party will leave Grand Central Station, New York, at 1:25 P. M. (daylight saving time), on Thursday, July 9, to arrive in Poughkeepsie at 3:14, where they are invited to inspect the De Laval Separator factory. This is one of the large factories that has successfully changed to the metric system. Those going directly from New York to Lake Placid may leave on the 8:10 P. M. sleeper. Reservations may be made in car No. 139. This train leaves Poughkeepsie at 10:21 P. M., and arrives at Lake Placid at 8:15 A. M. Those desiring to attend are asked to notify the Metric Association, 156 Fifth Avenue, New York, telephone Chelsea 9970. Information regarding the program, accommodation, trains, etc., will be promptly given.

Howard Richards,
Secretary

FIELD WORK OF THE VICTORIA MEMORIAL MUSEUM

Explorations and field work are being undertaken by the Victoria Memorial Museum at Ottawa as follows:

Dr. R. M. Anderson, chief of the division, expects to spend the latter part of the summer and early fall in biological reconnaissance work, principally in collecting mammals and birds in eastern Ontario and eastern Quebec south of the Gulf of St. Lawrence.

Mr. P. A. Taverner, ornithologist, will spend the months of June and July collecting specimens along the Red Deer River in Alberta with a view to clearing up doubts as to the breeding forms of the localities traversed and particularly to study the red-tailed hawk. He will be assisted by Mr. C. G. Harrold who, during the months of April and May, was engaged in southern Manitoba in securing for the museum specimens of migrant blue geese.

Dr. M. O. Malte, chief botanist, with Mr. W. R. Watson as assistant, is spending the summer in the foothills area of the Province of Alberta from the international boundary north to the Yellowhead Pass. His work is being done with a view to consolidating the botanical knowledge of the region in question which so far is comparatively vague.

Mr. C. H. Young is engaged in the collecting of material for the scientific staff of the museum in selected localities in the provinces of Nova Scotia and New Brunswick, and Mr. C. L. Patch and others will make short collecting trips from Ottawa in the interests of the museum.

Mr. Hamilton M. Laing, through the courtesy of the Mount Logan Expedition of the Canadian Alpine Club, was allowed to accompany it for the purpose of collecting natural history specimens. The area to be traversed is one from which we possess no material and concerning which we have but very vague knowledge.

Mr. J. D. Soper, in the summer of 1924, was despatched as naturalist by the museum with the expedition sent to Baffinland by the Northwest Territories Branch of the Interior Department. He wintered in the north and it is expected he will return to Ottawa when the Interior Department's boat makes its prospective trip during the summer of 1925.

Mr. W. S. Odell will, as opportunities present themselves, collect mushrooms and fungi in the vicinity of Ottawa.

Dr. E. Sapir, chief of the division, after completing some work in the office, plans on engaging in research on Athabascan and Haida linguistics at the Hupa Reserve, California, and Queen Charlotte Islands.

Mr. Harlan I. Smith will have as his principal work the direction of work intended for the preservation of totem poles in the Skeena River district, B. C. This work is being financed by the Department of Indian Affairs and the Canadian National Railways are cooperating in the work. Mr. Smith will incidentally carry on archeological and ethnological work as opportunities present themselves.

Mr. W. J. Wintemberg is engaged in archeological reconnaissance in the provinces of Saskatchewan and

Alberta, the tentative route laid out for him extending from Estevan, Saskatchewan, to Edmonton, Alberta, to Macleod, Alberta, and from thence easterly along the international boundary to the western boundary of Manitoba.

Dr. C. M. Barbeau is engaged in intensive study of the folk technology and colonial arts and crafts of the ancient French colony of Quebec and vicinity. The headquarters for this work will be on the Isle of Orleans.

Professor L. Bloomfield will be engaged in a study of Cree linguistics for a period of three months. His work will probably be carried on in the Province of Saskatchewan.

THE DISTINGUISHED SERVICE PROFESSORSHIP AT THE UNIVERSITY OF CHICAGO

AT the one hundred thirty-seventh convocation of the University of Chicago, held in Hutchinson Court on June 16, Professor Albert A. Michelson was appointed to the first of the distinguished service professorships established as a result of the present $17,500,000 program of development.

In raising new endowment of $6,000,000, the university has sought to obtain special funds in sums of $200,000, the income from which could be applied to the salaries of scholars of high rank, either already members of the faculty of the University of Chicago or men called from other institutions. This would establish virtually on a ten-thousand-dollars-a-year salary basis such distinguished service professorships, and would confer a special distinction upon those appointed, in addition to the increased income. The plan is considered also to be a recognition of scholarship which will encourage young men to enter the teaching profession.

"It was considered fitting by the university trustees," said Vice-president James H. Tufts, "that the first of these professorships should be awarded to a member of the present faculty, and that the choice should fall upon Professor Michelson, who has not only gained world-renown by his studies of the velocity of light and other problems of physics, but for years has been an inspiration to students and men with the spirit of discovery.

"This distinguished service professorship comes about as another instance of the generosity of Mr. Martin A. Ryerson, of Chicago, formerly president of the board of trustees, donor of Ryerson Physical Laboratory, and consistent friend of the university."

The presentation of this honor to Professor Michelson, head of the department of physics and winner of the Nobel Prize, the Copley Medal and other distinctions, comes on the eve of his departure for California where he will continue his remarkable investigations of the velocity of light.

SCIENTIFIC NOTES AND NEWS

IN connection with the forthcoming meeting of the International Astronomical Union at the University of Cambridge, it is proposed to confer the honorary degree of doctor of science upon the president of the union, President W. W. Campbell, of the University of California; also upon Professor F. Schlesinger, director of Yale University Observatory; Professor W. De Sitter, of the University of Leyden; Professor B. Baillaud, director of the Observatory of Paris, and Professor H. Nagaoka, of the Imperial University, Tokyo.

HARVARD UNIVERSITY has conferred the honorary degree of doctor of science on Professor W. J. V. Osterhout, formerly of the department of botany in the university and now a member of the Rockefeller Institute for Medical Research, and on Dr. John Jacob Abel, professor of pharmacology at the Johns Hopkins University.

YALE UNIVERSITY has conferred honorary doctorates of science on Dr. Donald Dexter Van Slyke, research chemist at the Rockefeller Institute, and on Dr. Robert Andrews Millikan, of the California Institute of Technology.

FRANK B. JEWETT, vice-president of the American Telephone and Telegraph Company and a past-president of the American Institute of Electrical Engineers, was awarded the honorary degree of doctor of science by New York University at the commencement exercises held on June 10.

DR. JOHN VAN WICHERIN REYNDERS, of New York, president of the American Institute of Mining and Metallurgical Engineers, delivered the commencement address at Rensselaer Polytechnic Institute, Troy, on June 19, and was awarded the degree of doctor of engineering by the institute.

DR. GELLERT ALLEMAN, professor of chemistry in Swarthmore College, received the honorary degree of doctor of laws from Gettysburg College on June 10.

COLONEL JAMES I. BRENNAN, M.E., city efficiency engineer and managing engineer of the city water supply system of Pittsburgh, has received the degree of doctor of science from Duquesne University.

DR. CHARLES ALBERT BROWNE, JR., chief of the bureau of chemistry in the Department of Agriculture, has received the honorary degree of doctor of science from the Stevens Institute of Technology.

DR. FRANCIS C. WOOD, director of the Crocker cancer research fund of Columbia University, has had conferred upon him by Tufts College an honorary Sc.D. degree.

Amherst College has conferred honorary doctorates of science as follows: Robert T. Miller, Jr., associate professor of surgery, the Johns Hopkins University; Whitman Cross, U. S. Geological Survey; George G. Sears, professor emeritus of clinical medicine, Harvard Medical School, and consulting physician, Boston City Hospital, and Edwin St. J. Ward, dean of the medical faculty of the American University of Beirut.

Dr. Karl Landsteiner, a member of the Rockefeller Institute for Medical Research, has been made a member of the Swedish Medical Society of Stockholm.

Dr. A. C. Seward, F.R.S., professor of botany and master of Downing College at the University of Cambridge, was reelected vice-chancellor of the university for the ensuing academical year beginning October 1 next.

At the annual general meeting of the Institute of Physics, of England, held on May 25, Sir William Bragg was elected president in the place of Sir Charles Parsons, whose term of office expires on September 30.

At a meeting on June 3, Mr. Philip Rowsell, F.C.S., was elected president of the Pharmaceutical Society of Great Britain.

Bertrand Russell has been appointed Tarner lecturer in the philosophy of the sciences, for 1925–26, at Trinity College, University of Cambridge.

Professor G. H. F. Nuttall, Dr. Hugh Scott and Mr. W. A. F. Balfour-Browne have been appointed representatives of the University of Cambridge at the International Congress of Entomology to be held at Zurich in July next.

At the annual meeting of the American Society of Clinical Pathologists, held at Philadelphia, on May 20 to 23, Dr. Frederick E. Sondern, New York, was elected president; Dr. William G. Exton, Newark, N. J., president-elect; Dr. Francis L. Burnett, Boston, vice-president, and Dr. Ward T. Burdick, Denver, secretary-treasurer.

The delegates from the American Medical Association to the annual convention of the British Medical Association at Bath, in July, are: Dr. William D. Haggard, Nashville, president of the American Medical Association; Dr. George E. de Schweinitz, Philadelphia, a former president of the American Medical Association, and Dr. Howard Fox, New York.

E. T. Dumble, consulting geologist for the Southern Pacific Company and its subsidiaries since 1897, having passed the prescribed age limit for active service, was retired on June 1.

The *Journal of the American Medical Association* states that the Massachusetts Psychiatric Society gave a dinner at the Hotel Somerset, Boston, June 5, in honor of Professors Kraepelin and Plaut, of Munich, Germany, who have been in the United States, Mexico and Cuba for several months, engaged in a study of general paralysis.

Dr. Vernon Kellogg, of the National Research Council, sailed for Europe on June 25 to attend the meeting of the International Research Council at Brussels on July 7 and following days. He will also represent the National Research Council at the meeting of the League of Nations' Committee on International Intellectual Cooperation in Geneva during the last week of July, and will later attend the meeting of the British Association for the Advancement of Science at Southampton as representative of the National Research Council and the American Association for the Advancement of Science.

Dr. B. M. Duggar, physiologist to the Missouri Botanical Garden, who has been appointed chairman of the division of biology and agriculture of the National Research Council, will spend the months of July and August at the summer office, at the Marine Biological Laboratory, Woods Hole, Massachusetts.

Dr. Gerald L. Wendt, dean of the school of chemistry and physics at Pennsylvania State College, attended the International Congress of Pure and Applied Chemistry at Bucharest, Roumania, during the week of June 21 and will spend the summer in Europe.

Mrs. Agnes Chase, assistant agrostologist in the U. S. Dept. of Agriculture, has returned from an eight-months' trip to Brazil. She has brought large collections of grasses. She visited the states of Pernambuco, Bahia, Rio de Janeiro, Minas Geraes and Sao Paulo.

Professor Prentice Reeves, of the department of psychology of the Ohio Wesleyan University, is spending the summer at the Munsell Research Laboratory in Baltimore.

Professor E. H. Johnson, head of the department of physics, Kenyon College, Ohio, has been granted leave of absence for the academic year 1925–26 for study at the University of Chicago.

A. E. O. Munsell, director of the Munsell Research Laboratory, Baltimore, is spending the summer as a working guest at the Bureau of Standards in Washington, where he is conducting research in colorimetry in cooperation with the section of colorimetry. Dr. Ferdinand G. Brickwedde (Johns Hopkins, 1925) has been appointed Munsell research associate in colorimetry in the bureau.

PROFESSOR HENRY E. CRAMPTON, professor of zoology in Barnard College, Columbia University, delivered the university oration on the occasion of the one hundred and seventy-first commencement, held on June 3, and presented the candidates for honorary degrees. At the annual initiation ceremonies of the Columbia Chapter of Sigma Xi, held on May 8, Professor Crampton delivered the address to the new members, under the title "The adventure of research."

PROFESSOR JAMES KENDALL, of the department of chemistry of Columbia University, returned on June 5 from a brief visit to Great Britain, in the course of which he delivered lectures on "The mechanism of Ester hydrolysis" before the Chemical Society of London and on "The rare earths" at the University of Edinburgh.

DR. WHEELER P. DAVEY, of the research laboratory of the General Electric Company, will deliver a series of lectures on "Crystal structure and its applications" at the summer session of the graduate school in the physics department of the University of Michigan. There will be eight lectures and eight conferences and laboratory periods in the weeks of July 6 and July 13.

PROFESSOR F. A. F. C. WENT, professor of general botany in the University of Utrecht, lectured on "Modern conceptions of light stimuli in plants" at the Imperial College of Science and Technology, South Kensington, England, on May 25.

THE governor of Massachusetts recently signed a resolve changing the name of the Massachusetts School for Feeble-Minded to that of the "Walter E. Fernald State School," in tribute to the late Dr. Fernald, who was superintendent of the school from 1887 until the time of his death on November 27, 1924.

PROFESSOR PHILIP SPONG (A.B. Butler 1922; M.S. Iowa State College 1923), head of the department of biology of the Wayne State Normal School, Wayne, Nebraska, died of pneumonia at Indianapolis, on May 21, 1925, age twenty-seven years. Professor Spong was a member of the Indiana Academy of Science, the Iowa Academy of Science, the Society of Sigma Xi, and the American Association for the Advancement of Science. He was particularly interested in entomology and herpetology.

THE death is announced at the age of seventy-eight of M. Auguste Pavie, French geographer and explorer.

PROFESSOR GIOVANNI BATTISTA GRASSI, distinguished for his work on the transmission of malaria, died on May 4, aged seventy-one years.

THE Swiss Society of Natural Sciences will hold its hundred-and-sixth annual meeting on August 8–11, at Aarau, on the river Aar in Switzerland. The scientific proceedings will be distributed over sixteen sections devoted to various aspects of science, and a number of lectures are announced in the general program.

THE Spanish-Portuguese Congress for the Advancement of Natural Science was recently inaugurated at Coimbra University, Lisbon, in the presence of a number of scientific men and men of letters from Spain, while representatives of French and Belgian academies of science were also present and the foreign ambassadors.

THE next International Congress of Entomology will meet at Zurich from July 19 to 26, with the Swiss entomologist Dr. A. von Schulthess as president.

THE ninety-third annual meeting of the British Medical Association will be held at Bath, England, at the close of July, under the presidency of Dr. F. G. Thomson, physician to the Royal United Hospital, Bath, and consulting physician to the Royal Mineral Water Hospital. The annual representative meeting, for transaction of medico-political business and discussion of the internal affairs of the association, will open at Bath on Friday, July 17. The statutory annual general meeting will be held on the afternoon of Tuesday, July 21, and on the evening of the same day the new president will deliver his address to the association. The twelve sections, among which the scientific and clinical work of the meeting is being divided this year, will meet on the three following days. On the last day of the meeting, July 25, there will be excursions to places of interest in the neighboring country.

THE Physiological Society of England has recently held in Leyden several joint meetings with the Physiological and Pharmacological Society of the Netherlands. At the close of the conference, a visit was paid to the laboratories of Professor Zwaardemaker in Utrecht.

A RUSSIAN Society of Endocrinology has been founded at Moscow. It is proposed to start a journal and a library. Medical men and biologists are invited to send copies of their publications of the last ten years to the secretary, Dr. N. A. Schereschewsky, Arbat 26, Moscow.

A PRELIMINARY meeting of the International Congress of Radiology will be held in London from July 1 to 4, under the presidency of Mr. C. Thurstan Holland. The congress will meet in three sections: (1) radiology; (2) electrotherapy and physiotherapy; and (3) physics. During the meeting there will be an exhibition of apparatus and books at the Central Hall, Westminster, and an exhibition of radiograms in the British Institute of Radiology, including those relating to papers read at the congress.

The new plant pathology laboratories at the Rothamsted Experimental Station, Harpenden, Herts., were opened on June 18.

Sir William Mulock, chancellor of the University of Toronto, has announced the completion of preliminary arrangements for the raising of $500,000 for the Banting Research Foundation.

The sum of £10,000 has been given to the London Hospital by Bernhard Baron to found a pathological institute, to be known as the Bernhard Baron Institute of Pathology. The hospital has also received £10,000 for the inauguration of the Owen Williams research fund, which is to be devoted to the prevention of disease.

An appropriation of $25,000 for the work of Rush Medical College of the University of Chicago has been voted by the university board of trustees. In addition Carl D. Greenleaf, of Elkhart, Indiana, has given $10,000 to the medical college.

The new house of the British Medical Association in London, now approaching completion, will be opened by the King on July 13. The medical profession officers of bodies cognate with the association, Dominion and Colonial delegates, and the president-elect of the American Medical Association will be present, and medical men from abroad, who will afterwards take part in the scientific proceedings at the Bath meeting, are also expected to attend.

Dr. Warren H. Lewis, professor of anatomy at the Johns Hopkins University, writes: The first number of a new journal, *Archiv für experimentelle Zellforschung besonders gewebezuchtung* (*Explantation*) has reached this country. It is edited by Rhoda Erdman, of Berlin, with the collaboration of American, English, Danish, French, German, Italian, Russian and Swiss investigators in the field of experimental cytology. The gradually increasing volume of work in this field during the past ten or fifteen years and the recognition of its fundamental importance in biology assures the success of a journal devoted especially to experimental studies on living cells.

Funds to defray part of the expenses of contemplated investigations in the field of therapeutics have been granted by the Therapeutic Research Committee of the Council on Pharmacy and Chemistry of the American Medical Association to the following: Dr. Montrose T. Burrows, research department, Barnard Free Skin and Cancer Hospital, St. Louis; Dr. Henry A. Christian, department of medicine, Harvard University; Dr. William S. Collens, department of physiology, Cornell University; Enrique E. Ecker, Ph.D., department of immunology, Western Reserve University; Dr. Robert A. Gesell, department of physiology, University of Michigan; Charles W. Greene, Ph.D., department of physiology and pharmacology, University of Missouri; Dr. Paul J. Hanzlik, department of pharmacology, Leland Stanford University; Treat B. Johnson, Ph.D., department of chemistry, Yale University; Dr. Edward B. Krumbhaar, Philadelphia General Hospital; Dr. Clayton S. Smith, department of physiological chemistry and pharmacology, Ohio State University; Dr. Alfred Stengel, medical division, University of Pennsylvania; Dr. Arthur L. Tatum, department of pharmacology, University of Chicago, and Dr. Carl J. Wiggers, department of physiology, Western Reserve University.

Dr. Murray P. Horwood, assistant professor of biology and public health at the Massachusetts Institute of Technology, has been asked to conduct a tuberculosis survey of Boston this summer for the Boston Tuberculosis Association. The survey will not only attempt to ascertain the facts concerning the anti-tuberculosis activities in Boston, but will evaluate them and use them as a basis for a more comprehensive and effective program. The work is being performed with the cooperation of the state and local health departments, the hospitals, clinics and the various social, welfare and voluntary health agencies interested in the anti-tuberculosis campaign.

A party of students and instructors from Louisiana State University spent the greater part of a week recently on Grand Isle at the mouth of Baretaria Bay, west of the Mississippi Delta. The trip was the annual field trip of the department of zoology, planned for the purpose of studying at first hand a typical Louisiana fauna. The time was divided between the Gulf beach life, that of the salt marshes at the back of the island, and that of the bay and the open gulf, both pelagic and deep sea forms, the last named specimens being obtained by trawling from one of the shrimp boats. There is also considerable bird life to be observed on the island; though none of the sea birds nests nearer than thirty miles away, they alight there in great numbers to feed. The island is likewise an excellent place for studying the migratory birds in passage. Collectors from the Louisiana State Museum told the university party that they had noted one hundred and fifty recognizable species of migrating birds passing over or alighting on Grand Isle two weeks previously.

THE Evaporated Milk Association has given two fellowships to the University of Chicago, one for $1,500 to the home economics department for determining the availability of calcium and other minerals, and the other to the department of hygiene and bacteriology for determining vitamin C.

Two industrial fellowships, as a mark of recognition of the lines of investigation pursued there, have been established in the departments of agricultural chemistry and bacteriology, respectively, of the University of Wisconsin. The Quaker Oats Company of America has given $3,200 to the former as an aid in securing impartial data on vitamins in cereals and their products with special reference to rolled oats and the antirachitic vitamin, and the Commercial Solvents Corporation has allotted $2,500 to the latter department working in conjunction with the other, to secure data on fermentation problems.

COLGATE AND COMPANY have established a research fellowship at the Woman's Medical College of Pennsylvania, in the department of chemistry, for the purpose of studying the causes of tooth decay. The first Colgate fellow will be Dr. Sylva Thurlow. The work is to be carried on under the direction of the professor of chemistry, Dr. H. H. Bunzell.

DR. A. W. CROSSLEY, presiding at the annual dinner of the Chemical Society, London, referred to the difficult position in which the society finds itself on account of the increased cost of publication. Subscriptions of fellows have been raised, various limitations have been placed upon the distribution of the society's publications, and papers are curtailed as much as possible, yet there is a financial deficit, and no practical means of avoiding it have yet been found. On this situation *Nature* comments: "During the war, chemists saved the nation from disaster by supplying drugs, poison gases and protection from them, and other products demanded by the times, and it does not seem too much to ask that assistance should now be afforded in placing upon record the work they are doing for the advancement of knowledge. When one remembers the vast sums expended upon the verbatim reports of proceedings in Parliament published in the large volumes of Hansard, and considers how trivial most of the matters are in comparison with the original contributions made to a body like the Chemical Society, it is difficult to understand the national sense of value which leaves the society in its present anxious position. Possibly the additional £1,500 received by the Royal Society in aid of scientific publication will enable a grant to be made to the Chemical Society, but in our opinion a very strong case can be made out by many other scientific societies for assistance towards costs of publication, either from the state or private benefactions, and we should like to see a concerted effort made with the view of securing adequate funds for this purpose."

UNIVERSITY AND EDUCATIONAL NOTES

GIFTS totalling $4,517,348, in addition to substantial contributions to the special $10,000,000 fund for chemistry, business and fine arts, were announced by President Lowell at the annual meeting of the Harvard Alumni Association.

PROFESSOR MELVILLE F. COOLBAUGH, of Golden, Colo., has been elected president of the Colorado School of Mines, succeeding Dr. Victor C. Alderson.

DR. WILLIAM S. ELKIN, for seventeen years dean of the Emory University School of Medicine, has resigned and has been elected emeritus dean and emeritus professor of obstetrics and gynecology. Dr. Russell H. Oppenheimer was elected dean to succeed Dr. Elkin.

DR. JASPER LUTHER BEESON, professor of chemistry in the Georgia State College for Women, Milledgeville, has been appointed dean of the College of Arts and Sciences in this institution.

DR. PAUL D. LAMSON, associate professor of pharmacology in the Johns Hopkins University Medical School, has been appointed professor of pharmacology at Vanderbilt University School of Medicine, Nashville, Tenn.

RICHARD M. SUTTON, for three years instructor in physics in Miami University, Ohio, has resigned to take a fellowship in physics at the California Institute of Technology.

PROFESSOR CHARLES SHATTUCK PALMER, who for the past year has been research chemist of the department of scientific research, Institute of American Meat Packers, Chicago, will rejoin the staff of the department of chemistry of Northwestern University in September.

DR. EDWARD SAMPSON, associate geologist, U. S. Geological Survey, has been appointed assistant professor of geology at Princeton University.

DR. WALTHER F. HOLST, son of President Axel Holst, of the University of Christiania, and discoverer of vitamin C, has been elected instructor in poultry husbandry at the University of California.

DR. WALTER NORMAN HAWORTH, professor of organic chemistry in the University of Durham, Armstrong College, Newcastle-on-Tyne, has been appointed professor of chemistry and director of the department of chemistry in the University of Birmingham, England, in place of Professor G. T. Morgan, who has resigned.

DAVID JACK, at present associate professor in the Carnegie Institute of Technology, Pittsburgh, has been appointed an assistant in the department of natural philosophy at the University of St. Andrews, England.

DISCUSSION AND CORRESPONDENCE

THE EXCESSIVE POLITENESS OF AMERICAN BOTANISTS

WHOEVER writes a novel or a collection of essays—and gets it published—feels that some one somewhere is likely to say, in print, just what he thinks of the book and why. The American botanist who writes a paper has, on the other hand, every reason to believe that he will have little difficulty in finding a publisher; and thanks to the excessive politeness or perhaps the indifference of his colleagues, he is also reasonably certain that no matter how poor the paper be, no one will tell him so even in print. This is merely another way of saying that American botanical literature is conspicuously lacking in adequate criticism. The probable causes of this lack will be discussed briefly in the present note.

There can be no question that we need criticism. Probably the only American botanists whose work is open to no criticism are those who have published no papers. Occasionally, the need of criticism is acute. For example, the February number of *Phytopathology* contained an article in which it was announced as a discovery that Rhizopus rot is an important disease of peaches in transit. The concluding paragraph strongly urged that pathologists give attention to this rot and study methods of control. No literature relative to Rhizopus rot of peaches was cited, although there are two recent American papers dealing with the subject, one of which was published in the *Journal of Agricultural Research* and the other in *Phytopathology* itself. To date, no review or criticism of this paper has appeared.

In general, we confine our criticisms of papers to personal discussions at times when neither the author of the paper nor the editor of the journal is present. In the February number of the *American Journal of Botany* there appeared an article on *poisonous* plants. This contribution contains such information as that ". . . the burrs of the chestnut produce mechanical injuries" and that "buckwheat cakes sometimes produce a dermatitis in people and hogs." The prevalent southern notion that "Buckwheat cakes and Injun batter makes you fat or a little fatter" was somehow overlooked. This paper was read aloud recently to a group of professional botanists assembled at lunch. It was greeted with undignified shouts of glee. Regarded purely as a humorous article it was a huge success, although two or three of the older members of the society which supports the journal did express the opinion that it was a disgrace to the society. One of them, who has been much in Europe, stated that on account of the publication of such papers we are rapidly losing our standing with European botanists. No one, so far as can be learned, has taken the trouble to write a serious review or even a letter to the editor.

It can not be successfully contended that American botanists lack the ability to criticize. Dr. Fernald's reviews of publications in his field are of unusually high quality and have added materially to his standing as a botanist. Dr. Heald's review of Stevens' "Fungi Which Cause Plant Disease" is a classic.

American botanists have also shown decided ability to appreciate criticism. The editorial review published in the *Gardeners' Chronicle* for February, 1921, of Dr. Coville's paper on the influence of cold in stimulating the growth of plants was widely read and appreciated by American botanists, including, we believe, the author of the criticized paper. More recently American botanists have read with interest, in the *International Sugar Journal*, Dr. E. W. Cross's review of Lee's paper on present needs in cane disease control.

Reference to the note in the *Gardeners' Chronicle* brings up the interesting question of why friendly and constructive criticism is more common in English botanical publications than in American. Without attempting to answer the question in detail it may be suggested that perhaps real criticism is lacking in American botany because of the great American tendency to move in crowds. Most American botanists of the present generation have been college trained; that is, they have been trained to boost for the old college and yell for the home team. They hate to offend personal friends. They realize that an incisive review may hurt the reviewer's chances of election to the vice-presidency of the section of oenotheriology of the Botanical Society of America—and so, the review is not written.

The need of adequate criticism in American botany being recognized, how shall it be met? In the literary field it is met by a special class of writers, many of whom in the past have attained high standing as critics. This solution of the problem is perhaps not possible in botany at the present time, although something similar has been suggested. Only recently, the distinguished professor of botany in one of our great universities wrote a Washington botanist: "Why does not the department establish a division of research criticisms and reviews and start a journal in that line?" This is emphasized by the pen note, "*This is serious and no joke.*" Granted the desirability of such a journal, why should it be conducted by the Department of Agriculture? Why should it not be established, for example, by the National Research Council? There could then be started somewhere else a journal of criticisms of the National Research Council and both publications would be assured of abundant material.

A criticism need not be caustic nor entirely unfavorable. It should call attention to the strong points of the article as well as its weak ones and it should never be anything but frank and honest. On occasion it may even have entertainment value.

The above notes while in manuscript form were referred for criticism to Dr. C. L. Shear. He returned them with a comment which so well bears out our central thought that we are quoting it in conclusion:

> In the case of young investigators it is little less than criminal to encourage or ignore hasty and poorly prepared publications, since by so doing their futures may be blasted and real contributions to science lost.

D. H. ROSE,
NEIL E. STEVENS

BUREAU OF PLANT INDUSTRY,
WASHINGTON, D. C.

ON THE DAYLIGHT VISIBILITY OF STARS FROM A MINE SHAFT

THE perennial question of the daylight visibility of stars from wells or mine shafts having been raised again, I have thought the following discussion might be of sufficient interest to justify a printed note.

Stars can, of course, be observed by daylight with a telescope. The image of a fixed star appears in a telescope as practically a point, but due to the light-gathering power of the objective of the telescope, is hundreds of times as bright as when seen by the unaided eye. The intrinsic brightness of the sky, an extended surface, can not be increased in the least. Consequently, on any clear day, the brighter stars are easily seen with a telescope of moderate size.

Now consider a person descending a well or a mine on a bright day. As one goes down, the patch of sky seen above becomes smaller and smaller, but from an elementary proposition in physics the intrinsic brightness is practically unchanged. The only change is the small loss due to atmospheric absorption, which will affect also any stars which happen to be in that area.

At a depth of a few hundred feet the general illumination would be greatly reduced, and the eye would be a little more sensitive; but since the contrast between the stars and the sky background is the same as at the surface, it is obvious that a star could be seen only if bright enough to be on the limit of visibility from the shade of any good sized building. The necessary brightness for daylight visibility is easily estimated from observations with a telescope, or obtained directly from observations of the planet Venus in midday.

With an objective of 6-inches aperture a star in daylight should theoretically appear about 1,000 times as bright as to the unaided eye. Further, it is found that the faintest stars which can be observed in midday with such an instrument give about one thousandth the light of the planet Venus at its maximum brightness. Making no allowance for atmospheric disturbances, we would expect these stars as seen in the telescope to appear about as bright as Venus seen with the unaided eye. But, as the "seeing" is always rather bad in the daytime and any disturbances are greatly magnified in the telescope, Venus at maximum brightness is an easier object to the unaided eye than such a star is in the telescope. As a matter of fact, Venus can be seen with no great difficulty on the best days when about half a magnitude below maximum. However, in the eastern and middle western states, one must have good eyesight and choose a very clear day to see Venus when as faint as thirty times the brightness of Vega, the brightest star which could be seen from a vertical mine shaft anywhere in the United States or Europe.

This is a pretty wide margin, and one naturally wonders how the stories started. A suggestion is that accidental views of Venus in the daytime are responsible. I have in the last twenty years personally known of several such, by persons with no astronomical knowledge. Any good news writer, hearing of such a glimpse of a "star" from an open window or cave opening to the south, could imagine that from a deep mine other stars could be seen. It should also be borne in mind that Venus passes overhead in tropical countries and should occasionally be seen from wells, shallow mines, large chimneys, etc., in those regions.

After the above was written, I spoke to Professor A. E. Drucker, a mining engineer of some twenty years' experience. His reply was that as one descends a deep mine the patch of bright sky at the top gets smaller and smaller, eventually looking like a star. He had never heard of any one's seeing a star by daylight from a deep mine shaft.

To summarize: Since the contrast between a star and the sky background would not be changed in descending a mine shaft, one could see a star only if practically on the limit of visibility from any spot above ground where the eyes are well protected from the glare of the sun. To be so seen a star must approach the brightness of Venus at greatest brilliancy. From this we can say that in the United States and Europe no stars could be seen from a vertical mine shaft with the sun above the horizon. Venus can often be seen in midday and at such times could be seen in these latitudes from inclined mine shafts pointing exactly the proper direction. Occasionally Mars and Jupiter might be so seen in the early morning or late afternoon hours. In tropical countries Venus, Mars and Jupiter all pass overhead at certain times and might on those occasions be seen from wells, large chimneys and shallow vertical mine shafts.

Charles Clayton Wylie

University of Illinois

TWINNING IN A MOLLUSC, SERPULOIDES VERMICULARIS

In view of a statement by Newman[1] it seems worth while to mention a possible case of twinning observed in embryos of *Serpuloides vermicularis*. Newman writes:

> I have never seen a reference to a case of twins or double monstrosity in Mullusca . . . characterized by *determinate cleavage* in its highest form. . . . It is no wonder then that in groups with strictly determinate cleavage we find no example of twinning, for twinning requires a totipotency of blastomeres or regions of the blastoderm.

Serpuloides is a sessile tubiculous mollusc living on the under sides of rocks in shallow water along the Pacific coast. Ovoviviparity is the rule. The young individuals are "born" with a simple coiled shell resembling that of an ordinary snail. The young *Serpuloides* soon become attached to the substratum and begin to grow in length. As they grow, they keep adding material at the mouth of the shell, gradually increasing its size so that a long irregularly coiled tube, resembling that of some of the polychetes, is produced eventually. The material in question, collected on the Pacific coast during the summer of 1923, consists of three pairs of "twins." In each case, two apparently normal young individuals, each with a larval shell fully formed but below the average in size, are contained in a single intact egg "shell," or membrane. These embryos were studied in the living condition and then fixed and preserved in alcohol for future examination. During life their movements were similar to those of other embryos at corresponding stages of development. Other preserved material on hand is being examined for possible earlier stages of such a phenomenon. This communication is presented as a suggestion that twinning is not impossible in the Mollusca, in spite of the determinate cleavage so characteristic of the group.

Richard P. Hall

The Rice Institute,
Houston, Texas

SCIENTIFIC BOOKS

Laboratory Manual of the Foetal Pig. By W. J. Baumgartner. New York: The Macmillan Company, 1924.

This is a laboratory manual that merits the consideration of every teacher of comparative vertebrate anatomy. It contains excellent directions for the dissection and study of a form hitherto largely overlooked, which presents certain obvious advantages over the dog, cat or other mammal more frequently the object of such study. Among these advantages the author calls attention to the following:

(1) The unlimited number of specimens which may be obtained at any good-sized packing plant with a minimum expenditure of time and labor.

(2) The convenient size of the specimens together with their ease of preservation.

(3) The absence of any objectionable odor or other quality that would make them objects of disgust to the most "finicky" student.

(4) The impossibility of any sentimental restrictions on their use arising from humane societies or antivivisection societies. Related to this is the fact that the student has no tender associations to be outraged as is sometimes the case where "pet" animals are used.

(5) The softness of the muscular and skeletal systems in the fetal pig make easier the dissection of the nervous and circulatory systems. And finally,

(6) The student gets a very good idea of the course of the fetal circulation in mammals.

The disadvantages in the use of this type of material are few and easily remedied. Some who have attempted it in the past have complained that the pigs become soft and "mushy." This is due to improper fixation and is readily overcome by following strictly the procedure described in this manual, which is the result of twelve years' experience. The imperfectly developed skeletal system can be readily supplemented with prepared skeletons, and the very immaturity of the pig gives the student an idea of bone development which he can not obtain from a study of mature animals only. There is left only the muscular system as a real difficulty and this can be remedied by the use of a few mature animals for the demonstration of the muscles, their arrangement and functions. This disadvantage is after all such a minor one that it is far outweighed by the greater usefulness of the pig in all other respects.

Typographically this book is up to the usual Macmillan standard. Only a very few errors have been noted, the most serious being the constant use of *"foeti"* as the plural form of *"fetus."* Not only does the correct Latin plural of this word end in *"-us,"* as in the singular, but attention may also be called to the fact that the *"oe"* in the first syllable is likewise not good usage. The Latin word is properly *"fetus"* in both singular and plural. One error in citation has been noted, *viz.*, "The Anatomy of the Domestic Animals," by Dr. Septimus Sisson, is referred to as the work of "A. Sisson." These are, however, minor errors which undoubtedly will be corrected in later editions. Professor Baumgartner, out of nearly twenty years experience in the teaching of large classes in comparative anatomy, has produced this manual for which he deserves the thanks of all teachers of that subject. He thus makes available for their use a form the availability of which has not been so widely realized as it deserves.

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[1] "The Physiology of Twinning," 1923.

University of Kansas H. H. Lane

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLIFIED METHOD OF MICRO-COMBUSTION: THE MICRO-DENNSTEDT METHOD

While we have no doubts as to the excellency of the micro-combustion methods of Pregel, we have encountered practical difficulties, which have forced us to abandon them. Micro-methods are gaining increased importance in biochemistry and a practical and easy method for determining the composition of organic substances in 5–10 mg quantities will open up new fields of research. Our work concerns mainly the determination of nitrogen according to Dumas and of carbon and hydrogen. In micro-Dumas, according to Pregl, we have obtained constantly too high results, while according to Dubsky the results were right from the start. The main difference in these two methods is the placing of the reduced copper in the tube and passing of the carbonic acid. We have combined the useful points of the two methods, namely, the combustion tube and Kipp apparatus as source of carbonic acid from Pregl, the placing of the reduced copper at the end of the tube and passing of CO_2, after the air is expelled, in small stream according to Dubsky. The results in this way are excellent.

Our main work concerns, however, the determination of carbon and hydrogen. Here, according to Pregl's method, we had out of seventy analyses seven good results, in spite of great care exercised in keeping to the original recommendations of the author. We have adapted the Dennsted's method for micro-work and had from the start almost 100 per cent. of good results and it seems surprising that this simple and excellent method has not been adapted before for the said purpose. The details of the method will be published elsewhere, and we wish here only to state the main advantages of our procedure: (1) An almost empty combustion tube, except for boats with absorbing substances, in which all the combustion is plainly visible; (2) the capacity and constancy in weight of the absorption apparatus, which last at least for 30 combustions, if not much more; and (3) the great ease with which the method can be acquired by workers familiar with the macro-combustion. Seven to ten days' practice is entirely sufficient for this purpose.

Casimir Funk
Stanislas Kon

Biochemical Department,
State School of Hygiene,
Warsaw, Poland

SPECIAL ARTICLES

BASIN RANGE STRUCTURE AT JEROME, ARIZONA

On a recent trip to Jerome, I was impressed, as on a much earlier visit, with the superb outlook from that town, when viewed with geological eyes, and was led to wonder why neither I nor apparently any one else had particularly called attention to the bearing of the structure, here so grandly displayed, on the problem of the origin of the Basin Ranges.

Jerome lies on the steep eastern front of a considerable mountain mass, known as the Black Hills, and overlooks to the east the Verde Valley. The town is roughly 2,000 feet higher than the Verde and nearly as great a distance below the summit of the Black Hills.

The geology of the district has been well worked out by Dr. L. E. Reber, geologist for the United Verde Copper Company, and those who wish may readily consult his paper.[1] For present purposes it is sufficient to state that at Jerome pre-Cambrian crystalline rocks are unconformably overlain by nearly horizontal Paleozoic beds with a total maximum thickness of about 1,500 feet. These in turn are overlain unconformably by basaltic flows of late Tertiary age, which still have a thickness of about 700 feet on the Black Hills, west of Jerome.

The outstanding structural feature of the district, as has been recognized by many, is a great normal fault which has a general north-northwest strike and outcrops along the eastern face of the Black Hills. The town of Jerome is situated on this fault and the major effects of the dislocation are plainly visible on the surface and in the mine workings. It is clear that the rocks east of the fissure have gone down relatively to those west of the fissure and that the throw is approximately 1,600 feet. North of Jerome, some of the same late Tertiary basalt that caps the Black Hills can be seen faulted down against the pre-Cambrian. These relations are shown in the following diagrammatic sketch.

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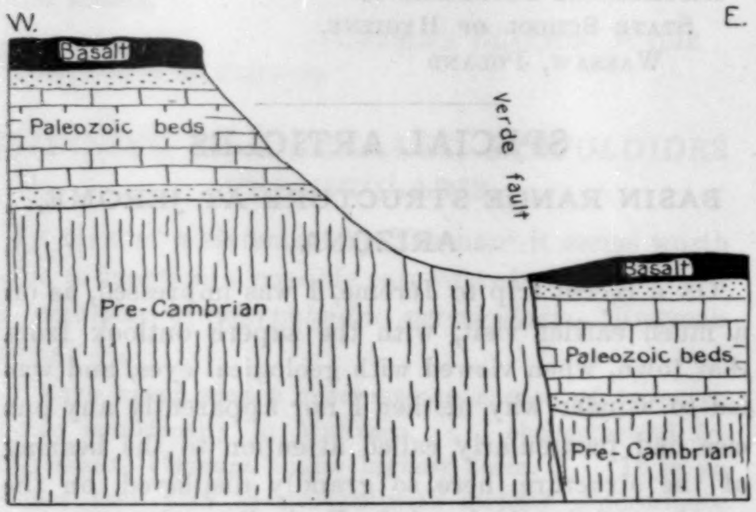
[1] Reber, L. E., Jr., "Geology and ore deposits of Jerome district," Trans. Am. Inst. Min. and Met. Eng., Vol. 66, pp. 3–26, 1922.

East of Jerome, between that town and the Verde River, are at least two other faults of similar character but probably smaller throw, so that the above section, if continued eastward, would show a succession of down-stepped blocks. These faults are apparently northward branches from what, south of Jerome, is a single great fault zone.



Diagrammatic section showing faulting at Jerome, Arizona

The points that deserve emphasis are (1) that the Black Hills with relation to the Verde Valley is an uplifted fault block; (2) that the faulting, inasmuch as it displaces basaltic flows that can scarcely be older than late Tertiary, is relatively recent; (3) that the basalt on top of the Black Hills is the same as that some 1,600 feet lower, just north of Jerome, and probably, also, the same as that known to underlie the thick accumulation of lake beds in the bottom of the Verde Valley; (4) that there is no evidence that the basalt on the Black Hills was ever covered by later sedimentary or volcanic deposits; and (5) that the present Verde Valley could not have been in existence when the basalt flowed over what is now the upper part of the Black Hills. The conclusion that the distinction between the Black Hills and the Verde Valley arose in late Tertiary or early Quaternary time as a consequence of block faulting is, I believe, inevitable, and Jerome deserves to take rank as a clearly demonstrable example of a type of structure which most geologists believe to be characteristic of the Basin-and-range province.

The existence, in Verde Valley, of a series of lake beds at least 2,000 feet thick, resting on basalt, and of supposedly late Tertiary or early Quaternary age[2] is additional evidence for the conclusion that the valley is essentially a structural feature and not a valley of erosion, although of course erosion has modified its original form.

F. L. RANSOME

UNIVERSITY OF ARIZONA,
TUCSON, ARIZONA

THE AMERICAN MATHEMATICAL SOCIETY

THE two hundred forty-second regular meeting of the American Mathematical Society was held at Columbia University on Saturday, May 2, 1925, extending through the usual morning and afternoon sessions. The attendance included sixty-three members of the society. There was no meeting of the council or of the trustees.

At the beginning of the afternoon session an address was made, at the request of the program committee, by Mr. J. R. Carson, of the American Telephone and Telegraph Company, and Dr. T. H. Gronwall, on "The Heaviside operational calculus and its application to electric circuit theory." A number of engineers and physicists were present by invitation at this session.

The following other papers were read:

The operational calculus: NORBERT WIENER.

Analytic approximations to topological transformations: NORBERT WIENER and PHILIP FRANKLIN.

Functions with assigned derivatives: PHILIP FRANKLIN.

On the types of division algebras: OLIVE C. HAZLETT.

On conditions for self-dual curves: T. R. HOLLCROFT.

The invariant system of two associated bilinear connexes: O. E. GLENN.

Algebraic surfaces with reducible bitangent and osculating hyperplanar sections: MARIA CASTELLANI.

The elementary divisors of a real symmetric matrix: J. H. M. WEDDERBURN.

The absolute value of the product of two matrices: J. H. M. WEDDERBURN.

The algebraic structure of the formulas in plane trigonometry: T. H. GRONWALL.

The behavior at infinity of the gamma and associated functions: T. H. GRONWALL.

A canonical form for biunivocal continuous sense-preserving transformations of a sphere: NORBERT WIENER.

Ricci's canonical congruences: HARRY LEVI.

Operations of Boolean algebras: ORRIN FRINK.

Alternatives to Zermelo's assumption. Preliminary report: ALONZO CHURCH.

Projective normal coordinates for the geometry of paths: OSWALD VEBLEN and J. M. THOMAS.

Conformal correspondence of Riemann spaces: J. M. THOMAS.

Asymmetric displacement of a vector: J. M. THOMAS.

On the inverse problem of the calculus of variations: J. H. TAYLOR.

On a certain functional equation: J. P. BALLANTINE.

ARNOLD DRESDEN,
Assistant Secretary

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[2] Jenkins, O. P., Verde River lake beds near Clarkdale, Arizona: *Am. Jour. Sci.*, 5th ser., Vol. 5, pp. 65–81, 1923.

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Next session begins October 2, 1925.

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SCIENCE NEWS

Science Service, Washington, D. C.

A NEW FORM OF COPPER

FOLLOWING on his announcement that he has produced big crystals of copper differing from ordinary samples of the metal, is the discovery by Dr. W. P. Davey, research physicist of the General Electric Company, that the metal prepared in this way possesses increased electrical conductivity to the extent of 13 per cent. Dr. Davey reported his investigations at the meeting of the American Physical Society held in affiliation with the American Association for the Advancement of Science at Washington on December 31.

While the use of single crystal copper is at present not a commercial possibility, the time is in sight when electrical machinery and conducting wires will be made of the new copper, thereby cheapening the cost of new power lines, and releasing a proportion of the metal which would otherwise be tied up in cables. Another way of regarding the superconducting copper is to consider that with conductors maintained at their present weight, energy losses on transmission lines would be reduced by 13 per cent., or, if the losses are permitted to remain the same, then smaller conduits could be used for underground work, and lighter towers could be erected for the support of overhead wires.

When Professor P. W. Bridgman, Harvard University, discovered that copper could be produced in relatively large crystals by the process of heating gradually in an electric furnace, and cooling down again equally slowly, Dr. Davey set himself to make copper crystals of appreciable size, and he succeeded in producing pieces nearly an inch in diameter and six incres long.

It was at once observed that these specimens could be bent without effort, but that they could not be straightened again. This is due to the fact that the distortion upset the balance of the atoms of copper, and they readjusted themselves into small crystals, so that the bar was to all intents and purposes, a piece of ordinary copper, and quite as inflexible.

Dr. Davey proved by X-ray examination that the treated copper really was just one big crystal, with the atoms arranged in regular rows from end to end, and he found that one of the axes of the cubic form in which copper crystallizes, ran through the single-crystal rod. Knowing that different axes of a crystal possess different electrical conductivities, he decided that his new copper should also conduct differently in different directions, and when the measurement was made it turned out that the resistance of the metal in the direction of its long axis was 13 per cent. less than before it had been treated. In order to make sure that there was no flaw in the argument, the crystal was hammered and them annealed, so that its uniform structure was spoiled, and then its conductivity was found to be the same as an untreated piece of copper.

Commercial copper was used in the test, and it was found that it would submit to the warming and cooling process. The important result was obtained, however, that single-crystal, commercial copper conducted better than the purest obtainable samples of the metal which had not been processed, and it exceeded even silver in the facility with which it permitted the passage of the electric current. Silver is the best conducting metal known.

THE CLIMATE OF MARS

THE climate on Mars is such that it may support life, mosses and lichens or trogdolytic animals able to withstand a freezing night and a thawing midday on that ruddy planet. These are the conclusions presented to the American Physical Society by Dr. W. W. Coblentz, of the U. S. Bureau of Standards, who, with Dr. C. O. Lampland, of the Lowell Observatory, Flagstaff, Ariz., has measured radiation from this planet and determined its temperatures accurately.

The north pole during the Martian winter has a temperature of 94 degrees below zero, Fahrenheit, and in summer the south pole is 76 degrees below zero. An estimated value for the night side of the planet is 112 degrees below zero, Fahrenheit. In the equatorial regions of the planet, higher temperatures corresponding to those on earth are attained during the day, reaching 41 degrees Fahrenheit. In the equatorial regions of the planet, higher temperatures, corresponding to those on earth, are attained during the day, reaching 41 degrees Fahrenheit in the bright regions and 59 degrees Fahrenheit in the dark regions. The integrated temperature of the whole disk is 22 degrees below zero.

"What about life on Mars?" Dr. Coblentz said: "That depends upon our point of view; whether we think of palm trees growing in our tropics, or mosses and lichens which grow on the apparently bare piles of volcanic cinders of Arizona and under our Arctic snows.

"The foregoing measurements show that for a few hours at noonday on the equator of Mars the surface temperature is not unlike that of Washington on some bright day in March. But consider the exceedingly cold nights and the great daily variation in temperature, amounting to perhaps 180 degrees Fahrenheit. Water is not present on Mars in sufficient quantity to form permanent lakes.

"Hence, with noonday temperatures of only 40 to 60 degrees Fahrenheit, even on the hottest spots on the equator, and with temperatures so low that probably all the water vapor freezes out of the atmosphere at night, it is evident that while vegetable and perhaps animal life appears to be possible on Mars it must be adapted to withstand prolonged drought and intense cold. Moreover, with such rapid temperature changes the reactions must be rapid. With most of the surface at Arctic temperatures it is reasonable to assume that if vegetable life similar to ours can exist on Mars, it must be like the mosses and lichens which thrive under our Arctic snows. Similarly, animal life must be trogdolytic, able to bur-

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ATMOSPHERIC NITROGEN

DIFFICULTIES in the path of those who would capture the nitrogen gas of the atmosphere, famous for its aversion for other chemicals, were brought to the attention of the American Chemical Society at its meeting in Washington by Dr. J. A. Almquist, of the Fixed Nitrogen Research Laboratory. Among the most promising of the methods so far introduced for accomplishing this result, which would cheapen fertilizer, is the making of synthetic ammonia. This pungent gas, formed by the union of three atoms of hydrogen with one of nitrogen, would then serve as the starting point for the manufacture of other nitrogen-containing substances.

Nitrogen and hydrogen can be caused to unite by the agency of catalysts, which are substances capable of producing reactions between chemicals unwilling to unite, although the catalysts themselves do not actually form a part of the new substance. This is the method to which Dr. Almquist has devoted his attention.

''We have made an extensive investigation of catalysts for this reaction,'' he said. ''Observations with materials of the iron type have shed light on the nature of the process involved.'' Just why the presence of one substance will set off a reaction between others when none of it is used up in the operation, is a point which still puzzles chemists, and one which is the subject of much investigation.

Dr. Almquist and his associates have found, in the case of the iron catalyst in ammonia synthesis, that the pressure under which the nitrogen and hydrogen gases are kept influences the efficiency of the catalyst; they find that the absorption of the product, ammonia, slows up the operation. It was previously thought that the iron had to take up some of the ammonia before it would work, but the experiments now show that this view is wrong.

Another difficulty in the way of large scale application of the technic is the fact that nitride of iron may be formed on catalysts which cuts down the surface at which the union between the two gases takes place.

ARTIFICIAL FAT AS A FOOD

TESTS under way at Teachers College and Columbia University for the purpose of deciding whether intarvin, an artificial fat for cases of chronic diabetes, exerts a harmful effect on the body, have shown to date that no evil results follow the inclusion of the material in the diet of rats, according to the report of Hattie L. Heft, Max Kahn and William J. Gies to the American Society of Biological Chemists meeting this week in Washington.

This material was invented recently for the purpose of providing a utilizable fat for persons suffering from acute diabetes who could not eat fat from natural sources. Sugars and fats are built upon a framework of strings of carbon atoms, to which atoms of oxygen and hydrogen are attached, and the surprising feature about the compounds containing a large number of carbon atoms, arm in arm, is the fact that nature invariably makes the chains out of an even number of links. It is on this point that the success of the artificial fat swings.

When a natural fat is utilized or ''burned'' in the body of a person afflicted with diabetes, substances such as acetone are formed which have for a backbone a chain of three carbon atoms, and then the breakdown process stops, instead of being carried on to the ordinary harmless end-products, water and carbon dioxide. But the diabetic products are poisonous and consequently the sufferer has to cut down on fat as well as on sugar. The inventors of intarvin decided to prevent the formation of these unfavorable materials by providing in place of natural fats an artificial one, containing an uneven number of carbon atoms. The idea stood the test of experiment. Artificial ''odd carbon'' fat was found edible and nourishing, and its manufacture is now carried on by the ton, the principle of the method being to knock one of the carbon atoms from the end of the chain which occurs in stearin, a common natural fat with an 18-carbon chain.

Consequently, intarvin is an alternative to insulin for coping with diabetes, the difference being that a special food is substituted for periodic injections of the hormone, insulin. In order to find out whether any deleterious effects may result in the long run from feeding on the synthetic fat white rats were provided with a natural, balanced diet, to which was added up to twelve per cent. of intarvin for half of the subjects of the experiment, while the remainder received instead an equivalent quantity of rendered lamb fat.

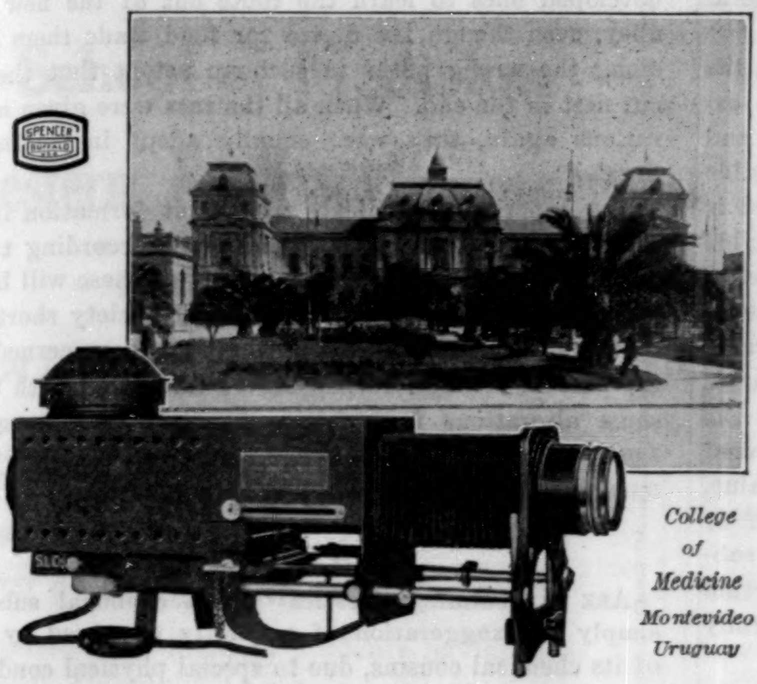
Mating was permitted between the corresponding animals in the two groups, in such a way as to prevent inbreeding, and, after seven generations, the rats eating synthetic food have shown themselves to be in every way the equals of those provided with natural fat. ''There have been no discernible effects on the animals treated with intarvin,'' these workers said. ''Their fecundity has not been impaired.

''Our study of the beneficial effects of intarvin in the treatment of diabetes has confirmed the earlier indications of its utility, and also of its lack of toxicity.''

THE ANTIRACHITIC VITAMIN

FURTHER clews in the tracking down of the mysterious accessory food factor or vitamin which prevents rickets were pointed out to the American Society of Biological Chemists by Drs. Alfred F. Hess and Mildred Weinstock, of New York, who are on the trail of the component of cod liver oil now well known as an effective substitute for the ultra-violet rays of sunshine in the banishing of bow legs, bad teeth and bending bones.

Cod liver oil supplies a curative and preventive principle, which is absent in vegetable oils, such as olive or cottonseed oils. But these oils, as well as green vegetables, such as lettuce or wheat, can be likewise endowed with the power of preventing rickets by exposing them



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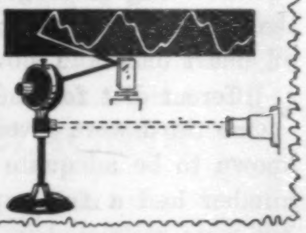

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to the rays of ultra-violet light from a mercury vapor or carbon arc light. The power so acquired is not immediately lost, but is retained by the lettuce for several days.

Further, according to the statement of the authors, the property imparted to otherwise inactive oils by the exposure to ultra-violet rays is of a permanent nature, and is retained for many months. "While it is impossible to state definitely that the substance which is formed is the same as that which is responsible for the remarkable curative value of cod liver oil, it has been found by means of chemical examinations that cod liver oil can be separated into two definite portions—one which is of value and one of no value in curing rickets," they stated. "The vegetable oils which have been exposed to the ultra-violet rays can likewise, and by the same chemical means, be separated into a portion which is of no value, and another which acts as a specific in warding off or curing rickets. It would, therefore, seem that a substance has been formed in the vegetable oils by the action of the ultra-violet rays, similar to that which is naturally present in the oil of the liver of the cod."

NUTRITIVE CONDITION AND HABIT FORMATION IN RATS

Feed a rat an imperfect or insufficient diet, and you sharpen her wits. Drs. Arthur H. Smith and John E. Anderson, who reported their experiments to the Washington meeting of the American Psychological Association, speak of their animals as "she's", not by analogy to the catty tribe, but because they chose female rodents in their studies of the relation between nutritive conditions and habit-formation. They thereby side-stepped the issue as to the relative brain power of the females and males.

They put a number of female rats into a maze, and noted the time they required to effect an exit. Next they divided their performers, by this time familiar with some of the wrong turnings in the maze, into three groups so that each one contained approximately an equal number of smart ones and slow ones, and each group was given a different diet for another month.

One third were given as much as they desired of food known to be adequate for health and growth; an equal number had a full supply of fat, sugars and vitamins, but were restricted in their nitrogenous food to a single source; and the rest were given just enough of a menu which included all the essentials that would maintain their weight. At the end of the training period, Group 1 had thrived, Group 3 were stunted and Group 2 showed that something was wrong with their food. When the animals were put into the maze again, it was found that those which had been partially starved were quickest to find their way to freedom and food, and similarly, the poorly fed rats won the race to find the way out of a new and different maze.

The new maze brought out the difference that the stunted rats made more mistakes on the new maze, even though they found the door first, and thus, although their starvation treatment had sharpened their intellects to the extent of refreshing their memories about the maze which they previously knew, it made it harder for the poorly developed ones to learn the route out of the new blind alley, even though the desire for food made them hustle along the wrong paths to such an extent that they got out first in the end. When all the rats were given normal rations again, they were equally adept in solving the puzzle.

The experiments indicate that habit formation is akin to physiological processes in the body, according to Drs. Smith and Anderson, and the results of these will be presented to the American Physiological Society shortly.

"The normal functions of the organs concerned with the process of habit formation are interfered with by the same alterations in nutritive conditions as have been found to bring about the well-known disturbances in metabolism, growth and reproduction."

ITEMS

Are "peculiar properties" of a chemical substance simply an exaggeration of a quality possessed by many of its chemical cousins, due to special physical conditions, such as a favorable temperature, under which it finds itself? This was the question raised by the report of Dr. Russell S. Bartlett, of Yale University, to the American Physical Society meeting in Washington. The electrical resistance of the metal, selenium, is known to vary with the amount of illumination which its surface receives, and this peculiarity is finding increasing practical applications in the construction of cells which vary an electrical current to a measurable degree when different amounts of light are allowed to fall on them. Among uses to which they have already been put is the turning off of beacon lights in the day time and the electrical transmission of photographs. Dr. Bartlett now finds that this is a property which many other metals possess, if they are kept at the temperature of liquid air. Bismuth was found to decrease in resistance to an electric current, when light shone on sheets kept in this extreme cold. Copper and platinum behaved similarly. "These results were first predicted from theoretical considerations," the physicist stated. Perhaps selenium's mysterious power is no more mysterious than the fact that mercury is unique among metals in existing in the liquid state at ordinary temperatures. Other metals are fluid when heated, while a mixture of the two metals, sodium and potassium, remains liquid.

Methods for getting purer extracts of chlorophyll, or the green coloring-matter of leaves, for use in medicine, industry and science, were described before the American Association for the Advancement of Science by Dr. Frank M. Schertz, biochemist of the U. S. Department of Agriculture. Chlorophyll is important in medicine as the basis for a remedy used in anemia. It is used in industry as a coloring for foods, toilet articles, soaps and leather. A pure extract is important in biochemical study because plants depend on chlorophyll and sunlight in the making of foods. Dr. Schertz's method involves the use of successive extractions and separations by means of acetone, petroleum ether, alcohol and distilled water.

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SCIENCE NEWS

Science Service, Washington, D. C.

SCIENCE IN 1924

SCARLET fever conquered, mercury turned into gold, the world circled by airplanes, photographs sent by radio and wire, stars given thirty trillion years of life, new stellar universes a million light years away discovered, vitamins isolated, ultra-violet light found to influence life processes.

These were some of the signal triumphs of science during 1924.

The discovery of the cause and the devising of a cure and susceptibility test for scarlet fever was the most important development of the year. Drs. George F. Dick and Gladys Henry Dick, husband and wife, working at the John McCormick Institute of Infectious Diseases, Chicago, demonstrated that hemolytic streptococci caused scarlet fever, that the use of a filtrate from a culture of this organism injected under the skin would produce a reaction if the person were not immune to scarlet fever, and that a preventive serum could be produced. Dr. A. R. Dochez, of New York, and Dr. F. G. Blake, of the Yale Medical School, also made contributions to the conquest of scarlet fever. A gradual but successful campaign against this disease will be the result of the development of these new weapons.

From Germany came reports that the age-old dream of the alchemists, the transmutation of a base metal into gold, has been accomplished. Professor Miethe, of Berlin, found minute amounts of gold in the mercury of a mercury vapor lamp that had been used in experimental work. Although other laboratories have not yet checked the results, and the quantities of gold are far too small to be commercially interesting, it is admitted that production of gold from mercury is theoretically possible and may have been accomplished.

As a consequence of the new physics, J. H. Jeans and A. S. Eddington, English astronomers, have determined that the life of a typical star must be at least thirty trillions of years. To match this immense figure, American astronomers have measured outposts in the heavens and determined that they are so far away that it would take light travelling at 186,000 miles a second a million years to come from them to the earth. The spiral nebulae, universes consisting of uncountable hosts of stars, are as far as this from the earth. This was the discovery of Dr. Edwin Hubble, of the Mt. Wilson Observatory. Dr. Harlow Shapley, of the Harvard College Observatory, also determined that the nebula N. G. C. 6822 is outside the Galaxy and is also a million light years away from our part of space.

As the culmination of many years of research and the perfection of instruments for communication, photographs were transmitted over telephone wires and radio within this country and from London to New York by radio across the Atlantic.

U. S. Army airmen circumnavigated the earth by air, thus becoming the Magellans of a new era.

One or more of the elusive food factors, the vitamins, have at last been isolated, and the relation between the antirachitic vitamin and ultra-violet light explained through biological researches at the University of Wisconsin and Columbia and Yale Universities.

THE GEOLOGICAL RECORD AND THE AMERICAN CONTINENT

IMAGINE an earthquake 200 miles wide, and stretching from one end of North America to the other! This is what happened on the west coast of this continent on at least two successive occasions, before the gigantic forces which folded and wrinkled the earth's crust were finally spent. Why geologists think these holocausts must have taken place was the story unfolded to the American Association on December 31, by Dr. Charles D. Walcott, secretary of the Smithsonian Institution and retiring president of the association, who has just completed a study of the record of this period in geology as it is written in the fossils and formations of the Rocky Mountains. Both oceans, and a great inland sea, washed up and down and in and out of the trough which was formed as a result of the first of these "quakes." The second exposed fossils through which can be traced the evolution of plants and animals.

Dr. Walcott said: "Many millions of years ago the downward pressure of the rocks beneath the Pacific ocean forced the lighter rocks of the western Americas to fold, crumple, break and often slide in great masses over one another. A great feature was the formation of a trough from 100 miles to 200 miles in width, extending from the Arctic Ocean to southern California, and lying 100 to 300 miles inland from the Pacific margin of the continent.

"In this trough the waters of the Arctic and Pacific passed freely and the animal life of both oceans migrated north and south and often mingled. The rivers entering the great 'Cordilleran Trough,' as it is called, brought pebbles, sand, clay and mineral matter in solution and the tidal currents and waves spread the sediments along the shores and far out over the bottom of the inland sea. This went on for countless ages, until 60,000 feet or more in thickness of sediments gathered in the deeper sections of the trough. All through the ages the marine life gradually changed as its evolution went slowly forward in the waters of the great Pacific area. Large groups of life came in, flourished for a few centuries, and disappeared, to be replaced by other and later faunas. Occasionally other forms came in from the Arctic, the interior continental seas and rarely the Atlantic province. Great continental seas sometimes crossed the eastern barriers of the trough and swept over the area, bringing new sedimentary conditions and new life. The transgressing seas often wore away the rocks of

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A dish-shaped stage permits the fragments to be examined immersed in water; the bottom of the dish has a ruled square of 5 cm. x 5 cm., this being subdivided into 25 smaller squares of 1 x 1 cm., thereby facilitating the counting of grains.

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previous ages and left a graphic story of their advance.

"After the close of the many-million-year old Paleozoic epoch the pressure came again from the Pacific and the sandstones, shales and limestone formations of the Cordilleran Trough were folded, broken and often pushed up into mountain ridges to form the western shore line of continental marine and fresh water seas, in which are the records of the development of the vegetable and animal life from the tree ferns to the giant sequoia and the cold-blooded fishes and lowly reptiles, to the warm-blooded mammal and finally man."

PLANT FOSSILS

WHAT were the climates of geological periods millions of years ago? Can there be a science of "paleoclimatology"? It looks difficult, for clouds and sunshine and lightning flashes do not leave bones or shells behind them. But Dr. David White, chairman of the division of geology and geography of the National Research Council, has an answer. He studies the records of ancient climates as they left their mark on the plants of those remote periods, which did leave their fossils behind them. Speaking before the Washington meeting of the American Association for the Advancement of Science, he summarized his studies.

In the most ancient of the rocks that yield any recognizable organic remains, assigned by geologists to Cambrian, Ordovician and early Silurian periods, there were few or no land plants. Remains of primitive blue-green seaweeds, however, indicated an abundance of sunny weather over the warm, shallow seas. Later in the Silurian, types of amphibious plants evolved from the seaweeds; they required immersion part of the time, but were stiffened sufficiently to endure exposure to the world above the waters for considerable periods.

In the next period, the Devonian, the development of land plants had proceeded to a point where they formed extensive swamps, as demonstrated by beds of peat; and huge seaweed-like things with trunks three feet in diameter stood up in the sun. The climate must have been rather even, for the plants did not develop annual rings as trees do now; and there was plenty of dry, sunny weather.

Then came the earlier coal age, the Mississippian. This was, for the most part, warm and rainy, apparently all over the earth, for fossils of subtropical plants are found in the Arctic. The coal age proper, or Pennsylvanian, followed; also with an equable, and apparently warm climate well distributed. The subtropical quality of the climate is indicated by the richness of the plant remains, the great thickness of the coal beds, and by the lace-like delicacy of the leaves of many of the plants. There were extensive swamps, for fossil-tree stumps show thickened bases and "knees" such as are found in swamps to-day. There was considerable wind, for winged seeds were common. Again, in the latter part of this age, the fossils show that harder times had come, for the delicate-leaved plants disappeared, and tougher plants, inured to desert conditions, began to show up.

The early period of geology closed with the Permian, which ended with the dawn of the Mesozoic, or Middle Ages of geology. This Permian age began with a glacial epoch, such as the earth experienced recently, but more severe and longer-enduring. Queer fern-like plants, adapted to severe climates, mark this frosty time. Then came another long season of equable weather, though part of it at least had seasons of cold or drought, for annual rings again appeared in perennial plants. But the great climatic feature of this age was its close, when the whole world apparently was scourged with drought. Plants adapted to desert conditions of life dominated the earth, and the first ancestors of certain modern conifer families appeared.

According to Dr. White, we are living in an abnormal period. "Relative equability and mildness of climate are, geologically speaking, normal," he said. "Great climatic range and variability, both seasonal and geographic, are abnormal, and are, I believe, confined for the most part to periods of diastrophic revolution, such as that in which we live."

APPLICATIONS OF X-RAYS

DOCTORS and detectives, chemists and jewelers, farmers and mechanics; all these and others now apply X-rays to their work, said Professor George L. Clark, of the Department of Chemical Engineering at the Massachusetts Institute of Technology, in a paper read before the American Association for the Advancement of Science.

"We little realize," said Dr. Clark, "in the process of application of X-rays to diagnosis of human ills and to the obliteration or alleviation of suffering, that this same agency is being applied by the botanist, the physicist in his searching of atomic anatomies, the chemist, the metallurgist, the great industrial corporation or even the ordinary mechanic, to the solution of almost innumerable problems."

Dr. Clark divided the applications of X-rays into three classes; first, those depending upon direct utilization of the radiations; second, the determination of the structure of crystals, and, third, the testing of theories of the structure of the atom. As examples of these applications, he cited forty-one different uses to which the Röntgen rays are put. Besides the more familiar ones of medical diagnosis and the treatment of tumors, they are used now, as the result of the invention of a small portable outfit, by plumbers to find the location of pipes in walls, electricians to locate wires and by carpenters to find beams and nails before proceeding on new constructional work.

Botanists have made experiments with them and it has been found that seeds exposed to their action germinate more rapidly. Some chemical reactions are also accelerated by them, while others are retarded. When precious stones, such as diamonds, are exposed to them, they fluoresce, or give off light, and this permits them to be used by jewelers to detect imitation jewels.

In the second group, largely the result of the work of two English scientists, Sir William Bragg and his son, Professor W. H. Bragg, great advances have been made, and it has been found possible to determine just how the

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The Field of PSYCHOLOGY—1924

By MADISON BENTLEY, Ph.D.,
Professor of Psychology and
Director of the Psychological Laboratories
University of Illinois

The Field of Psychology is designed to orient the trained individual outside the subject as well as to inform the student of psychology. To the man of science, venturing outside of his own *Fach,* a new "ism" offered in a foreign discipline may, for the want of guidance, appear as plausible and as generally representative as a seasoned body of facts and principles. The credulity frequently displayed by physicists and biologists in alleged instances of "telepathy," "clairvoyance" and "mediumship" illustrates the difficulty of sound and authentic judgment in matters beyond one's specific training. *The Field of Psychology* maintains that a catholic survey "calls" for the most rigorous criticism and for the most unsparing rejection on every side; that it means the salvage of all that is worth keeping from the psychological labors and laboratories of Europe and America; but that it implies as well the extraction of whatever is *psychologically* substantial in Freudian doctrine, in behaviorism, in phenomenology, in the alleged arts of "testing intelligence," in the attractive doctrine of the *Gestalt,* and in all the other products and proposals of recent years. It appeals as little as possible to dogmas and theories; and it avoids as much as possible the neighborly distractions and allurements of biology, sociology, education and medicine.

Of special interest to the physicist and the physiologist will be the author's critical comparison of observation and measurement in psychology and in the physical sciences (Chapters II, IX, XVII), the descriptive analysis of understanding and discovery (Chapters XIV, XV), and the socialization and development of the total or psychological organism (Chapters XVIII–XX).

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molecules that make up crystalline material are arranged. It has also been found recently, by a Belgian, Dr. Smidt, that the structure of the molecules of liquids may be determined.

The latest developments have been in the third group of applications, and has been found useful as a check on theories of the structure of the atoms themselves. Also this work has led to the prediction and subsequent identification of a new element, hafnium, and some of the conclusions have been found to check with the theory of relativity.

Who would have dreamed in 1895, when the Röntgen rays were discovered, that in 1924 they would have these numerous applications, Dr. Clark concluded, and asked "Whither shall the science of X-rays have led us in another thirty years?"

THE SOURCE OF MUSCULAR ENERGY

WHETHER muscles can secure from fat the energy which they need to contract and relax was the question discussed by Dr. Graham Lusk, of Cornell University Medical School, at the meeting last week of the American Physiological Society, meeting in affiliation with the American Association for the Advancement of Science. Dr. Lusk answers "yes" to this query, which is one of prime importance to students of the human body, since it bears on the particular function in the diet of two of its chief constituents, *viz.*, sugars and fats, and it likewise determines what changes must take place in these two classes of nutriment before they can serve as the source of the body's muscular energy. European physiologists, headed by Dr. A. V. Hill and Dr. Otto Meyerhof, maintain that sugars alone are the source from which the muscles derive their energy, but Dr. Lusk opposes this theory. It requires that all the fuel which supplies the muscle machines must first be converted into the form of lactic acid, which is a carbon-containing acid present in sour milk.

Dr. Lusk cited the case of a dog which had fasted for 13 days. When such an animal ran at the rate of three miles an hour, it consumed fat alone. Supporters of the "lactic acid" theory also contended that sugar is a more efficient food to use than fat, but this claim is not allowed by Dr. Lusk. A fasting dog converted fat into energy just as efficiently as the same animal which had eaten a mixed meal, containing plenty of sugars.

Dr. Lusk stated that the production of fat in the body from carbohydrate, or sugar, is a well-recognized occurrence, but he warned that this observation must not be included as evidence in favor of a theory which requires that sugar must be manufactured out of fat, before the latter becomes available to supply part of the body's muscular energy.

"There is no existing evidence to support the conclusion that fat must first be converted into lactic acid in order to be available for muscular power," asserted Dr. Lusk in throwing aside the deductions of the European scientists.

ITEMS

CHEMICAL and physiological tests, including scientific measurement of the amount of alcohol in the breath, furnish the most accurate method of determining when a man is intoxicated, Dr. H. L. Hollingworth, of Columbia University, told psychologists this week in Washington. He reported experiments in which accurate measurement was compared with the subject's own report on his condition and with observations of the subject's general appearance and conduct made by witnesses. Witnesses, he found, could detect only the largest dose used and its effects. The subjects themselves could identify effects of small doses, but measurement correctly indicated much smaller doses. The poorest of these methods, that of relying on the report of witnesses, might be useful for practical and legislative purposes, but such rough observations should not be confused with the final verdict of science.

THE long, gray festoons of Spanish moss, that form romantic draperies on the trees in the South, must get its food somewhere for all plants must. But since it has no roots and spends its whole life in the air, how does it get the necessary mineral salts? Drs. Edgar T. Wherry and Ruth Buchanan, of the Bureau of Plant Industry, U. S. Department of Agriculture, have been asking themselves this question, and repeated it before the Ecological Society of America. "Analyses of its ash showed it to contain unusually large amounts of sodium, iron, silicon, sulphur and chlorine," said Dr. Wherry. "A sample from near the sea-coast proved to contain more chlorine than one from some miles inland, suggesting that the source of this element is spray from the ocean which the wind carries up to high levels, and is then brought down by the rain. The sodium and sulphur may reach the plant in the same way, but where the silicon and iron come from is a mystery."

EVOLUTION'S queer trick, that took a plant that looked like a fern and turned it into a plant that looks like a palm, though it is neither a fern nor a palm, was brought out in an address by Professor Charles J. Chamberlain, of the University of Chicago, before the botanical section of the American Association for the Advancement of Science. The cycads, sometimes called "cycas palms," have been the life study of Professor Chamberlain, in pursuit of which he has travelled all over the tropics of the world, especially in southern Mexico, Cuba, Australia and South Africa. These plants are of little economic importance to-day, but the fossil remains of their ancestors are of immense importance, for out of the fern-like leaves of the so-called "fern cycads" of the Paleozoic Age was formed most of the coal of the world.

COPPER hydroxide used as a spray is not only a strong fungicide, but fifteen times more active than the more common spray, Bordeaux, Dr. Henry D. Hooker, of the University of Missouri, reported to the American Society for Horticultural Science. He believes that the active ingredient of Bordeaux mixture is copper hydroxide. An advantage of copper hydroxide is that it leaves no stain on the trees.

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SCIENCE NEWS

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DEFLECTION OF X-RAYS

X-RAYS can be refracted by solid substances, it was stated at the recent Washington meeting of the American Physical Society by Professor Manne Siegbahn, of Upsala, Sweden. Doubt has existed as to whether X-rays are diverted from their course by substances which they pierce, but this is removed by these investigations, in which the amount of the deflection was actually measured. It is well known that a straight stick put slanting into water, half in and half out, appears to be bent due to the fact that the liquid refracts the rays of light coming from the lower end of the stick to the eye. This is the principle on which the theory of lenses is based, since polished pieces of glass of the proper shape deflect a beam of light passed through them. The production of a band of spectral colors when a beam of light passes through the corner of a glass prism is caused by the varying refraction of the different colors which compose the white light, and which differ in wave length. A similar phenomenon was observed in the case of the invisible X-rays by Professor Siegbahn and his associates, who secured a photographic record of the fan of rays which resulted when a beam of X-rays was turned on a suitable crystal. X-rays can also be reflected from the surface of crystals if they strike at the right angle. This, again, is analogous to the reflection of light by mirrors.

IRON IN THE STONE AGE

THE use of iron was known to the Stone Age man, Dr. Albert Sauveur, of the Harvard School of Engineering, told the Third Pan-American Scientific Congress, meeting in Lima. Hammered implements of meteoric iron have been found in the ancient mounds in Ohio.

"So simple was the operation required for extracting a small mass of malleable iron that primeval man may well have discovered it by means of a fire accidentally lighted on ground where iron ore existed near the surface."

The first iron furnaces were a single excavation on the side of the hill facing the prevailing wind with an opening at the bottom for the draft. In this appliance the ore was heated, and in contact with charcoal, a small pasty mass of iron was obtained.

These primitive furnaces were called bloomeries. Very early in the development of the iron industries an artificial blast was introduced. In the south of Europe artificial blast furnaces were used long before the Roman invasion.

It was not until the early part of the twentieth century that steel began to take the place of wrought iron manufactured as it was in the days of Cort in the seventeenth century. With the development of Bessemer steel, although it needed high-grade ore, wrought iron was practically rendered obsolete. No improvement in the Bessemer process has been recorded; however, iron ore has been reduced by electricity as a source of heat and carbon as a reducing agent. Manganese steel appeared to startle the metallurgical world some years ago by its extreme resistance. It was not until 1914, however, that stainless steel, an alloy of steel, was announced by its discoverer, Harry Brearly. Its adaption for the manufacture of cutlery was immediately appreciated and it is now widely used for that purpose.

In concluding his outline of the development of iron Dr. Sauveur called attention to the rich deposits of ore in Chile and prophesied that they would furnish much of the material for American furnaces as the ore is from 65 to 68 per cent. of iron and is of Bessemer grade.

THE BRIGHT STAR ALGOL

ALGOL, the bright star in the constellation of Perseus, seen nearly overhead in the early evenings now, is not a single orb, as it appears to the naked eye, but actually consists of three, and possibly four, separate bodies, all revolving around in a complicated system, said Dean B. McLaughlin when speaking before the astronomers gathered in Washington to attend the meeting of the American Association for the Advancement of Science. Mr. McLaughlin, who is a member of the staff of the Sproul Observatory of Swarthmore College, has studied the star on the basis of the radial velocity, or the speed with which it approaches or recedes from the earth.

The most peculiar feature of Algol is the periodic variation in light which it undergoes, and which caused the ancients to call it "The Demon Star." This variation has been known for a long while to be due to a dark body, or satellite, which revolves around it in a period of a little over two days, and which, when it comes between the earth and the star, cuts off the latter's light. However, certain discrepancies which were found in the period of variation has made it evident that there is a third dark body which the eclipsing pair revolve around in a little less than two years. Mr. McLaughlin has discovered a further discrepancy, and he comes to the conclusion that these three bodies revolve around a fourth one in a period of somewhat more than a century.

THE CLIMATE OF THE EARTH

DR. W. J. HUMPHREYS, of the U. S. Weather Bureau, pointed out at the recent meeting of the American Association for the Advancement of Science that the sun has nothing to do with determining the climate of the earth as all the changes were produced essentially by the earth itself and no matter how constant the output of solar energy certain alterations of topography and other terrestrial conditions determine climatic changes.

It is further believed that during the warmer periods of prehistoric times the land areas were relatively restricted and of small elevation with the oceanic circulation free and open to high latitudes.

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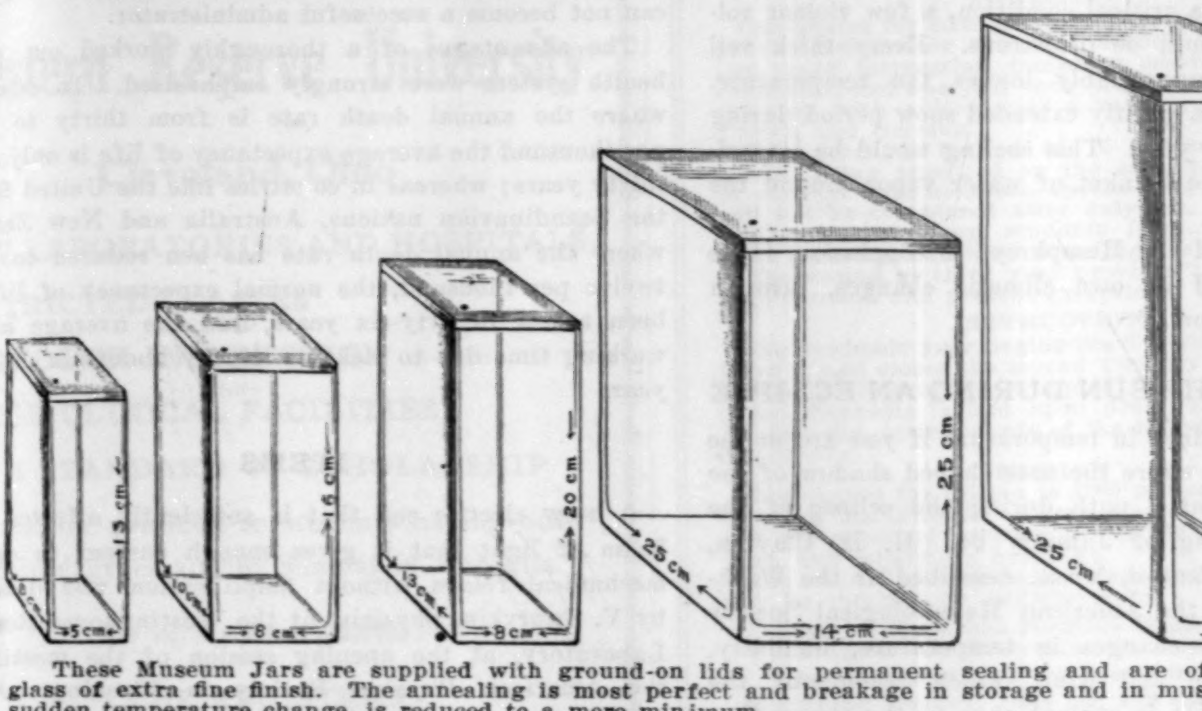

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The colder periods, including the ice ages, were, presumably at times when land was extensive, mountains abnormally high, and oceanic currents restricted. At such times the mountain peaks would carry many glaciers of greater or less magnitude. At a time like this, when the climate was in a critical condition, a few violent volcanic eruptions would be disastrous. Every thick veil of volcanic dust appreciably lowers the temperature. This would lead to a greatly extended snow period during every season of the year. This cooling would be intensified by thinning the blanket of water vapor around the earth.

"In short," said Dr. Humphreys in conclusion, "the earth has produced its own climatic changes, through potent natural factors."

HEAT FROM THE SUN DURING AN ECLIPSE

Look out for a drop in temperature if you are in the northeastern states where the cone shaped shadow of the moon will mark out a path during the eclipse of the sun on the morning of January 24. H. H. Clayton, meteorologist, of Canton, Mass., described at the Washington meeting of the American Meteorological Society on January 3 the changes in temperature, humidity, barometric pressure and wind, which accompany the moon's shadow. "It is evident even to the senses that the temperature falls within the shadow of an eclipse," he said. "Part of this is due to the withdrawal of the direct heating effect of the sun's rays, and part to the actual cooling of the air by radiation." The temperature has been known to fall off as much as ten degrees, the coldest time being shortly after the totality of the eclipse.

Records of sensitive barometers have shown that superposed on the usual variations in air pressure is a wave due to the presence of the shadow, which has three crests, occurring shortly after the beginning of the phenomenon, at its height, and just at its completion. Disturbances in the moisture content and circulation of the air are likewise reported, but observers do not agree on these points.

PUBLIC HEALTH ADMINISTRATION

An outline of the needs of a successful public health administration was presented before the Third Pan-American Scientific Congress, in session at Lima, by Dr. J. D. Long, assistant surgeon general, U. S. Public Health Service, and vice-director of the Pan-American Sanitary Bureau.

After outlining the antiquity of public health service, and describing in brief the sanitary measures exercised in ancient Babylon, Egypt, Persia, Greece and Rome, Dr. Long stated as his opinion that modern public health measures can be carried out to best advantage on a basis of local autonomy. If each community is allowed to work out its own local problems, and to meet them according to the means available, a more flexible system and better results are to be expected than where the administration is highly centralized.

Dr. Long also pointed out the desirability of separating the professional and technical end of the work from the administrative and clerical. Physicians and sanitary engineers should not be expected to spend too much time on office work. Frequently, moreover, a trained scientist is very valuable in his profession, but can not become a successful administrator.

The advantages of a thoroughly worked out public health system were strongly emphasized. In countries where the annual death rate is from thirty to forty per thousand the average expectancy of life is only about thirty years; whereas in countries like the United States, the Scandinavian nations, Australia and New Zealand, where the annual death rate has ben reduced to about twelve per thousand, the normal expectancy of life has been raised to fifty-six years, and the average loss of working time due to sickness is only about six days per year.

ITEMS

A new electric cell that is sufficiently affected by a beam of light that it gives enough current to operate mechanical relays without amplification was described by V. Zworykin, physicist at the Westinghouse Research Laboratory, at the opening session of the meeting of the American Physical Society in Washington. The device consists of a bulb in which there are four electrodes, and which is coated with a distilled alkali metal, with the exception of a small window for the admission of light, and filled with the rare gas argon under low pressure. One electrode acts as a filament and is heated to a low temperature, special shields preventing the light from reaching the sensitive coating.

That variations in the electricity of the atmosphere show a definite relation with activity on the sun, as measured by the number of sun-spots and which are known to undergo a cycle of about eleven years, was brought out by Dr. Louis A. Bauer, director of the Carnegie Institution's Department of Terrestrial Magnetism, in a paper presented before a joint session of the American Physical Society and the American Astronomical Society. Data have been obtained during the last eighty years, covering seven sun-spot cycles, and show that the relationship undoubtedly exists. "The indications are good," he said, "that, with increased improvement in method of measurement, atmospheric electricity may assist powerfully in solving the mooted question as to the manner in which striking occurrences on the sun, as sun-spots, may affect physical conditions on the earth."

Blue mold, one of the worst spoilers of food, is a tough customer and hard to kill, according to results of experiments reported by Miss Katherine G. Bitting to the Botanical Society of America. In the experiments, mold spores and remains of cultures that had been grown twelve years ago and kept in a dry condition ever since were found to be still alive and capable of reproducing. Some samples, that had been grown on foods containing chemical preservatives, had been injured by their early experiences, as they showed by producing abnormal forms.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE BACTERIOPHAGE

THE controversy over the existence of living organisms so small that they can not be seen in the most powerful microscope was renewed at the Washington meeting by the statement of Dr. Lloyd Arnold, Chicago, to the Society of American Bacteriologists that the active principle which causes the breakdown of the bodies of bacteria is not a living thing. Ever since the first claim by the French-Canadian bacteriologist, Dr. F. d'Herelle, to the effect that he had demonstrated the existence of organisms of approximately the size of some of the large molecules with which chemists are acquainted, scientists have been divided on the question. With the first announcement, d'Herelle claimed the new form of life preyed on bacteria, and that the taking into the body of an active culture of the invisible germ would convey immunity to many diseases.

In 1923, some seven years after the first discovery, opponents of the living organism theory admitted that d'Herelle's technic had value in the treatment of dysentery, and positive evidence was obtained that the immunizers prepared according to his direction materially assisted in the cure of this disease. Those working on the subject at the time maintained, however, that an enzyme, or ferment, was responsible.

Subsequently bacteriologists were forced to the conclusion that the "bacteriophage," to use the name given to the minute bacteria-eaters, was not confined in its appetite to organisms harmful to man, but that it also attacked certain bacteria of the soil which play a vital part in maintaining its reserve of nitrogen. This was countered by the discoverer of bacteriophage with the statement that he had actually measured the size of the organisms.

That d'Herelle's doctrine is still disputed is proven by the report of Dr. Arnold, however, who flatly denies the existence of such a small "germ." His experiments have shown that bacteriophage really behaves according to the important laws of chemistry; that the question of proportion enters, and that the usual response of the substances recognized by classical chemistry to changes in temperature, and rate of combination or neutralization, is also made by bacteriophage. In other words, the pseudo-organism obeys the laws relating to known toxins and antitoxins.

Summarizing d'Herelle's work, which implies a parasite invisible to the most powerful microscope, and capable of passing through some solid materials, Dr. Arnold said: "We can not substantiate this. We have shown that the agent which causes the dissolution of the bacteria is a toxin or ferment-like substance, and not a living, ultramicroscopic parasite." Dr. Arnold would put the bacteriophage in the same class, chemically, as snake venom. He does not deny that the strange serum possesses peculiar properties, however, such as the power to reproduce itself, when a small portion is placed in a nutrient solution.

CAUSES OF TOOTH DECAY

A SPECIAL germ, deficient diet and predisposing conditions in the mouth combine to foster decay of teeth, according to Drs. F. E. Rodriguez and R. A. Kelser, of the Army Medical School, Washington. Dr. Rodriguez has found that an individual germ of the lactic acid family is the one responsible for the piercing of the hard enamel of the teeth and exposing the soft dentine inside to many different types of bacteria. It thrives in an acid medium, and itself produces an acid condition.

The germs are now being used on rats in order to see whether it is not possible to produce diseased teeth artificially in the living animal, since experiments on isolated teeth have been successful. "I hope that within five or six months, we will be able to duplicate in rats the changes which take place in the teeth of human beings," Dr. Rodriguez stated.

These investigations do not prove that the mere presence of the causal organism is the only requirement for the appearance of dental decay, it is pointed out. Conditions of diet must prevail which foster the growth of bacteria, and further, it must be easy for them to lodge in the mouth so that the etching process can go on. "I believe that the two factors are of equal importance," Dr. Rodriguez said. "The environment in the mouth must be favorable to the organisms."

This is why three sets of rats are being used in the experiments designed to produce artificial decay. One group gets a perfect diet; a second group receives an unusually high percentage of sugar, and a third set receives food which is deficient in calcium and in fat-soluble vitamin A. Dr. Rodriguez then watches the development teeth of the rats, and follows the changes which result when the mouths of the rodents are infected with the lactic organisms. The high-sugar diet is used to provide the offending organisms with plenty of material for the manufacture of acid, and the deficient rations are employed to study the function of calcium salts and the fat-soluble vitamin in the formation of teeth, as some investigators claim that sound teeth can not develop unless there are adequate supplies of each of these two substances.

PREPARATIONS FOR PHOTOGRAPHING THE ECLIPSE FROM THE "LOS ANGELES"

THE advance party of the world's most unique eclipse expedition is installing upon the U. S. Navy dirigible "Los Angeles," in her hangar, cameras and other apparatus that will photograph and record for science the total eclipse of the sun on January 24. Professor F. B.

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Some of the new constructions offered by the Leitz Works caused a revolution in microscope models and optics.

Littell, captain, U. S. Navy, and Professor George H. Peters, both of the U. S. Naval Observatory, Washington, are in charge of the battery of cameras, telescope lenses and spectroscope that will temporarily turn the cabin of the "Los Angeles" into an astronomical observatory.

The equatorial telescope camera will be used to photograph the mysterious corona of the sun, a pearly halo that can be seen only during the few brief minutes of total solar eclipse. This instrument is being adjusted to the limited space of the air liner's cabin and the exact routine of the aerial eclipse expedition is being outlined with the cooperation of the officers of the "Los Angeles," Commander J. H. Klein commanding.

Every second of the time will count, for even at the favorable position selected for the dirigible, 100 miles off the Atlantic coast on the central line of the eclipse, the length of time that the sun will be completely covered by the moon will be only two minutes and seven seconds. By reaching an altitude of 4,000 to 6,000 feet above the ocean the astronomers hope to avoid clouds and haze that may obstruct the view of the solar phenomena from observers on land.

Tentative plans for the expedition call for a 3:00 A.M. departure from Lakehurst on the morning of the eclipse which will occur at 9:15 A.M. at the position selected for the dirigible. The astronomical party will be in charge of Captain E. T. Pollock, superintendent of the U. S. Naval Observatory. Arrangements are being made to keep the public in touch with the progress of the expedition by radio.

PHOTOGRAPHY OF INFRA-RED RAYS

Use of the large 36-inch reflecting telescope at the Steward Observatory of the University of Arizona to photograph a house six miles away was described at the Washington meeting of the American Association for the Advancement of Science by Dr. A. E. Douglass, director of the observatory. These experiments were made to test a new photographic plate sensitive only to infra-red rays invisible to the human eye. Comparisons were made of the results obtained with the usual types of photographic plate, and it was demonstrated that while the latter exaggerated all the haze of the atmosphere, those taken by infra-red light produced a result as distinct as that taken a short distance away.

These plates were also used by Dr. Douglass to photograph Mars during the time of its close approach last summer and it was found that they showed the markings on the planet far more distinctly than those of the usual kind. In view of these results, the opinion has been expressed by Dr. D. H. Menzel, of the University of Iowa, that it seems evident that Mars itself has an atmosphere, which, like that of the earth, cuts out most of the blue light which affects the ordinary plate and transmits the red and infra-red radiations.

Dr. E. C. Slipher, astronomer at the Lowell Observatory at Flagstaff, Arizona, and a leading authority on Mars, told of somewhat similar experiments. In an effort to test the accuracy of drawings of Mars made with the aid of their large telescope, an enlarged photographic copy of a drawing was taken to a point a mile and a half from the observatory and photographed with the telescope in the same way as the planet itself. The result, as it appears on photographs shown by Dr. Slipher, shows the straight lines of the drawing representing canals as indistinct patches, on account of the distance of the drawing. Most striking, however, is the similarity of these photographs to ones made at the same time of the planet itself and which show similar markings. This, in the opinion of Dr. Slipher, is convincing proof of the presence of the canals, the very existence of which have been doubted by some astronomers.

THE MEXICAN BEAN BEETLE

Within the next two or three years, bean growers of eastern Michigan and western New York will probably suffer heavy losses from the ravages of the Mexican bean beetle, was the prediction made at the meeting of the American Association of Economic Entomologists by Neale F. Howard, associate in truck crop insect investigations of the U. S. Bureau of Entomology.

This insect pest is now within 150 miles of these two greatest bean-growing districts of the east. Since its discovery in Alabama in 1920, Mr. Howard said, the Mexican bean beetle has spread rapidly and steadily at the rate of about 150 miles per year to the north and almost half as far per year to the east, until it is now present in 12 states and may possibly be present in three others.

Neither the destructive capabilities of this species nor the actual damage is as great as in the case of many other insects, and it can be successfully controlled by the use of magnesium arsenate, he said.

J. E. Graf, entomologist in charge of truck crop insect investigations of the U. S. Bureau of Entomology, pointed out that temperature and humidity are not important factors in limiting the distribution of the Mexican bean beetle as it has become a pest in three separate areas in North America—one arid, one humid, and a third with dry winters and heavy rainfall during the summer.

The habit of cleaning itself makes the Mexican bean beetle easy to control and may be the means of preventing further serious ravages by this damaging crop pest, Professor S. Marcovitch, of the Tennessee Agriculture Experiment Station, told the entomologists. When the plants are dusted with sodium fluosilicate or mustard gas on charcoal, all that is required is for the beetle to walk over the dusted plants. When he does this, the dry powder sticks to his legs and body. These materials cause irritation, so that the beetle starts washing his feet. The material thus enters the mouth and death takes places in a few hours.

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who has been conducting investigations in the fourteenth and fifteenth centuries, reported to the Washington meeting of the History of Science Society in a symposium on medieval science that other remarkable advances in science had been made during this comparatively unknown time.

The hospitals were kept scrupulously clean. Bed linen was changed often, and stoves were wheeled to the bedsides of patients during the winter. The systematic practice of dissecting the human body was generally practiced. At this time leprosy almost disappeared from Europe, and other contagious diseases were isolated. Mercury salve was used in the treatment of syphilis early in the fifteenth century about the time it was supposed to have made its first appearance. The study of natural sciences, however, declined, due not to religious opposition but because of the failure of the universities themselves to promote interest in the study.

Dr. George Sarton, of Harvard University, also stressed the progress during the so-called dark ages. Dr. Louis J. Paetow, of the University of California, said that although there was a keen interest in Aristotle and his works during the early part of the century it gave way to other subjects. "It became the fixed idea during the middle ages that the mystery of existence could be solved by logic, philosophy and revelation," he commented. "Gradually all interest centered on these branches and the university thought became stereotyped expressions of it."

SPREAD OF THE CHESTNUT BLIGHT

THE chestnut blight, which has till now been supposed to have reached as far as central Virginia, has taken a tremendous stride and appeared in southwestern North Carolina, according to G. F. Gravatt, of the office of forest pathology, United States Department of Agriculture. On a recent reconnaissance trip in the south Mr. Gravatt discovered a considerable area in the famous Saluda district of the Blue Ridge Mountains which showed signs of severe blighting. He estimates that the original infection dated back about ten years; the disease is now well under way in Henderson County.

Before this giant leap of the chestnut blight it had been thought feasible to check the disease by cutting down all the chestnuts in a wide swathe around the main area of infection and so "firing back" in the way that prairie fires are stopped. The outbreak of the disease in the Saluda district removes all hope of this.

The big chestnut tan bark companies in North Carolina, where the finest stands of chestnut in this country are located, are undecided whether it will be best to lumber over all the available chestnut at once and so drug the market or to cut slowly and run the risk that the blight will get there before the sawmill. Blight-killed trees are useless for the tanning industry.

Chinese and Japanese chestnuts, with which the Department of Agriculture hopes to replace the native species, are reported to be very successful in all trials thus far. The Chinese chestnut promises to fulfill the three requirements of a perfect chestnut: it will develop blight-resistant strains, furnish a bark useful in tanning and produce good nuts for eating.

PRESENT EXISTENCE OF PRIMITIVE MAN

THAT fragments of the primitive, apelike Neanderthal race of men, commonly regarded as long since extinct, may still be alive in some unexplored corner of Africa or Australia is the view advanced by a noted French anthropologist, Professor R. Verneau. A study of several of the lowest known savage races has led him to this conclusion.

Anthropologists at present regard the human genus as having once existed in two distinct species, Neanderthal Man and Modern Man. The theory holds that Modern Man drove out and exterminated the Neanderthal species. There seems to be little doubt that this was what happened in Europe, for skulls and other remains of the extinct race have been found, but no people exist there with Neanderthaloid skull measurements or other physical characters. But in certain primitive tribes in Africa, Australia and the East Indies, Professor Verneau has found men with strong resemblances to the supposedly extinct race, and he is of the opinion that in the unexplored interior fastnesses there may be others who are still more like their "missing link" ancestor of fifty or a hundred thousand years ago.

Professor Verneau was recently awarded the Huxley Medal, the highest honor that the Royal Anthropological Institute of Great Britain and Ireland can bestow.

ITEMS

FRESH lubricating oil and refined kerosene may be salvaged from the used oil in crank cases. By agitating the used oil with a solution of sodium silicate and then distilling with steam an oil may be recovered which compares favorably with new lubricant, according to F. H. Rhodes and H. J. Haon, Jr., of Cornell University. Because the salvaged oil has been heated to such a high temperature it is even better for use than fresh oil for automobiles as it is not so easily cracked. The residue could then be blended with naphtha or casinghead gasoline and be used either as a motor fuel or as kerosene.

PROFESSIONAL astronomers do not realize the importance of observations of meteors and they should make an effort to learn more about them, is the opinion of Professor C. P. Olivier, of the Leander McCormick Observatory. He urges that two special observatories be established in different parts of the country, to photograph meteors simultaneously. By comparison of the plates, many facts could be learned about their height and motion, he said. Credit was given to the members of the American Meteor Society, a group of amateur astronomers who have made many meteoric observations and have helped greatly in augmenting our knowledge of these fiery visitors.

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SCIENCE NEWS

Science Service, Washington, D. C.

STRENGTH OF ATHLETES

"STRONG as a horse," spoken admiringly of a mighty athlete, is not so great an exaggeration as it sounds. Exact studies of the physical exertion put forth by the members of the famous Yale crew of 1924 by Drs. Yandell Henderson and Howard W. Haggard, of the department of applied physiology at Yale, show that each man developed, during the period of a race, about one-half horsepower.

Determinations of energy expended were obtained in various ways. The men were exercised individually on rowing-machines with power meters attached; the ratio of the amount of oxygen taken in to the amount of carbon dioxid given off in breathing was determined: the racing shell they used was towed by a power boat with a spring balance set into the towline.

"The data from these three methods were in general in fair agreement," says Dr. Henderson. "They indicate that the maximal power exerted is from .45 to .55 horsepower per man, or expressed in the heat equivalents, 4.8 to 5.9 calories per minute, with a total energy expenditure of 19 to 29 calories per minute, or 13 to 20 times the basal rate."

It was noted that these athletes did not puff and blow noticeably, however great their exertion; this is in marked contrast with the distress of untrained or half-trained men. The amount of oxygen they took in through their lungs reached about the limit of the carrying power of heart and blood; yet it was not sufficient to replace the amount burned up during the race. As Dr. Henderson expresses it, "He draws heavily on his credit and incurs oxygen deficits; these deficits are repaid by the high rate of oxygen absorption for a time after the work is ended."

THE TYPHOID EPIDEMIC

AN epidemic of typhoid fever, novel because its exact source is unknown, is spreading over the country and has reached rather serious proportions in Chicago, New York, Pittsburgh and Washington.

The cases are confined principally to the homes of the wealthy and to persons over fifteen years of age. "These facts alone relieve milk and water supplies of any suspicion of taint," said Dr. W. F. Draper, assistant surgeon general of the U. S. Public Health Service. Lettuce, under suspicion by the health officers in Pittsburgh, has also been given a clean bill of health.

Public suspicion points to oysters as the cause, and in the popular mind a clear case of circumstantial evidence has been built up against them. Due to fear of oysters and other shellfish the oyster growers have suffered financially, as their sales have fallen off to half. There is a possibility that the source of infection may be traced to "bootleg" oysters which have been stolen from polluted and condemned beds and sold in open market. In Chicago a twenty-five dollar fine has been announced as the penalty for eating raw oysters, and they are under ban in the states of New York and Pennsylvania.

Typhoid fever is nearly four times as prevalent now as in normal times according to the latest U. S. Public Health Service data. One hundred and five cities reported 197 cases of typhoid fever for the last week in December, 1924, as against 54 for the same week in 1923. Under ordinary circumstances, these cities may be expected to develop on an average 52 cases during that particular period.

The U. S. Public Health Service is making a survey under the direction of Dr. L. L. Lumsden, of every person in the badly infected areas who has typhoid in an attempt to find out the source of the infection. As soon as the data has been completed the results will be announced so that doctors and laymen may guard against the outbreak.

ULTRA-VIOLET LIGHT AND VITAL PROCESSES[1]

MANY of the papers read before the Washington meeting of the American Association for the Advancement of Science were devoted to showing how rays of a certain sort affect vital processes. We have learned that vitamins are good for us. Now we are told that sunshine is good for vitamins. Not the whole of the sunshine but mostly the part that consists of waves too short to be seen. We can understand better what the physicist means by such talks since we have been playing with radio. Our receivers are arranged for a certain range of wave lengths, say from two hundred to six hundred meters. But we all know that there are longer waves in the ether that we can not get and we are afraid that the broadcasting stations will soon be sending out shorter waves that our instrument will be inadequate to receive so we shall have to buy a new one. Now our eyes also can only receive a limited range of vibrations. There are long waves in the sunshine that are invisible though we feel their warmth. And out where the blue begins and even beyond the violet limit of visibility there are rays that will darken a photographic plate, or our skin if we lie in the sun too long. These short ultra-violet waves that burn or tan our skin will kill bacteria, and it has recently been found that taken in moderate amounts they may increase resistance to bacterial infection and stimulate various bodily processes in men and animals. They may cure tuberculous sores and swellings. They assist somehow in the laying of lime in the bones and so prevent rickets. To prevent children from becoming bow-legged it has been the custom to give them doses of cod liver oil but it has now been found that a daily dose of sunshine will do as well. Dr. Steenbock of Wisconsin has recently found that hogs kept in the shade and fed on inadequate diet will become crippled in the legs if kept in the shade, but they thrive on the same diet if

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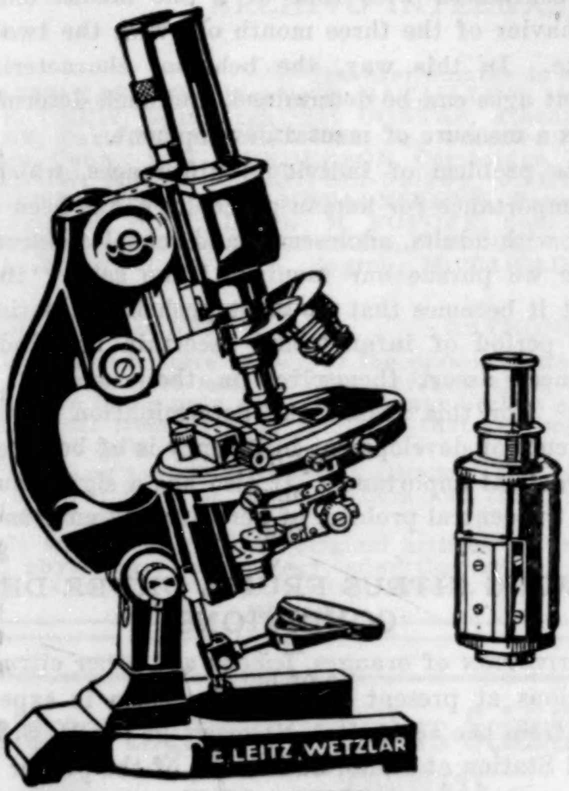

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permitted a place in the sun, a hint to farmers that they may well supplement their fodder with sunshine. Egg-laying like bone-making requires lime-using. So we are not surprised to learn, although we had not thought of it before that these short waves will aid the hen in her maternal duties. Drs. Hughes and Payne, of Manhattan, Kansas, have found that hens exposed once a day for ten minutes to an electric lamp source of ultra-violet rays laid four times as many eggs as those which did not have the light treatment. The eggs from the irradiated hens had thicker shells, contain more lime, and twice as many of them hatched. I expect we soon shall see "ultra-violet eggs" advertised for sale and at an ultra-price. Dr. Goodale, of the Mount Hope Farm, Williamstown, described at this meeting a sun porch expressly contrived to give chickens the benefit of these magic rays. Dr. Hess, of New York, as well as Dr. Steenbock, has shown that ordinary vegetable oils may be made as good as cod liver in preventing rickets by being rayed with ultra-violet. Dr. Hess found that when rats were fed on foods deficient in the anti-rickets vitamin, the addition to the diet of the white sprouts of wheat grown in the dark or even of green lettuce from the market did not prevent rickets. But if the wheat or lettuce be exposed to ultra-violet radiation for two minutes, it became active in preventing bone weakness.

The action of the ultra-violet rays on the skin affects the whole body. Exposing the left wrist to the rays will cure rickets in the right wrist as well, so it seems that the rays must activate some substance in the skin which carries the healing virtue throughout the system. Dr. Hess suggests that it may be the crystalline chemical known as cholesterol which is contained in animal and vegetable cells and is especially abundant in the outer skin. He has found that pure cholesterol, dissolved in water and exposed to ultra-violet rays, will prevent rickets as well as cod liver oil.

Invisible light is a two-edged sword. The same ultra-violet rays that are now used to save children from the crippling rickets disease, produce misformed monsters when turned on the eggs and embryos of lower animals. Dr. Marie Hinrichs, of the University of Chicago, told the American Association for the Advancement of Science of producing freak fish with one eye, distorted hearts, queer tails and other abnormalities, by subjecting the eggs from which they developed to ultra-violet radiation for half a minute.

The secret of the death and distortion wrought by these rays, she said, is due to the fact that they attack not the weakest, but the strongest place. Wherever life processes are going on most rapidly, there the rays strike and kill first. The parts that will be the brain, the eyes, the spinal cord, the heart, are first to be awakened to life in the developing egg, and the rays affect the more inert portions of the egg tissue lightly or not at all while they work their mischief on the highly vital parts. If the exposure is continued for more than a fraction of a minute, death spreads to the other parts and becomes complete, but by learning the exact moment at which to withdraw their baleful influence the organism may be left alive, but diverted from its normal course of growth.

INFANT BEHAVIOR

Declaring that clinical studies have shown that a month of retardation in the first year of life may be as serious as a whole year of retardation in later school life, Dr. Arnold Gesell, of the Yale University Psycho-Clinic, has pointed out the possibility of measuring the mental growth of babies by their behavior.

Dr. Gesell presented the results of comparisons of behavior of infants at ages of 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 months. These infants were observed in pairs at the Yale clinic, behavior of a two-months old child being contrasted with that of a one month old child, the behavior of the three month old with the two month old, etc. In this way, the behavior characteristic of different ages can be determined, and such determination used as a measure of mental development.

"The problem of individual differences, which is of basic importance for human psychology, has been studied mainly with adults, adolescents and school children. The further we pursue our inquiries," he said, "the more evident it becomes that we must push investigation back to the period of infancy and ascertain how individual differences assert themselves in their earliest genetic stages. For this reason the determination of monthly increments of development in infancy is of both scientific and practical importance. It also has a significant bearing on the central problem of heredity and environment."

GROWING CITRUS FRUITS UNDER DESERT CONDITIONS

Cultivation of oranges, lemons and other citrus fruits in regions at present too arid for them is expected to result from the accidental discovery at the U. S. Experimental Station at Indio, California, of the proper method to induce flowers and fruit on the Australian desert lime tree.

The Australian desert lime is the only plant closely enough related to citrus fruits to permit grafting, that will grow under desert conditions, in alkaline soil, and in greater cold than other citrus species will stand. As a stock on which citrus fruits may be grafted it has long been expected to extend the range of orange and lemon culture into regions hitherto unsuitable.

The only difficulty was that it would not produce seed, no matter how generously irrigated; and no seed, no grafting stock. A specimen that stood near an irrigated terrace, and received a constant small trickle of water surprised workers at the station by breaking into bloom, whereas other trees that had had their roots copiously flooded once a month refused to put forth a bud. This hint that what the trees really needed was a constant small supply of water, instead of intermittent floods, was acted upon; so that now an abundance of young seedlings are available for propagation purposes.

STERILITY IN POTATOES

That our cultivated potatoes are pretty close to being exclusively female in their nature is the conclusion of Drs. A. B. Stout and C. F. Clark, investigators for the U. S. Department of Agriculture.

Potatoes have long been known to form flowers, as toma-

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Editorship

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A comprehensive survey of the present state of general biology as well as any detailed researches concerning its problems have met, up to the present time, with extreme difficulties, the literature discussing this new branch of science being only accessible in numberless studies and articles scattered in many periodicals devoted to various special researches, so much so that the importance of general biology for future scientific work can as yet hardly be fully appreciated.

Our new journal **BIOLOGIA GENERALIS** is meant to do away with these obstacels by concentrating most of the original work of living authors and continually adding a short impartial review of what might still be published elsewhere.

It will be open to all original articles on any of the three branches of General Biology, i.e., general **morphology, physiology,** and **ecology,** admitting all methods and courses of research save purely metaphysical investigations. Contributions in **English, French, German, Italian** and **Russian** will be accepted.

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toes and peas do, appearing to be of the same double male and female constitution of the latter; yet potato flowers rarely set true fruit enclosing seed as in the case of tomatoes and peas. A long current explanation attributed this failure to the growth of underground tubers which drew food from the aerial parts. That this is not the correct reason appears from the fact that potato shoots grafted onto the roots of non-tuberous relatives develop flowers that are no more fruitful. Moreover, in those few varieties that do form seed-containing fruit it has ben observed that tuber and seed formation go hand in hand.

Intensive studies revealed the true cause of the sterility. They found that the pollen is almost completely shrivelled up and devoid of life in the great majority of potato varieties. Good pollen, capable of fertilizing flowers, is very rare. The female elements of the potato flower, however, do not share in this degeneration. When good pollen is used on a pistil almost all potatoes can be induced to form ''balls'' containing true seed.

Potato varieties have retained their femaleness and nearly lost their maleness and if it were not for the lucky expedient of tuber production most of our varieties would quickly become extinct.

TEST OF THE THEORY OF RELATIVITY

FURTHER tests of the theory of relativity will take place if the suggestion of Dr. Ludwik Silberstein to the American Section of the Astronomical Union is adopted. The meeting in Washington of the American section was in preparation for the meeting of the International Union next summer at Cambridge, England.

According to Dr. Silberstein, the theory of relativity rests upon three experimental proofs. One of these, an apparent displacement of stars seen at the time of a total eclipse of the sun, has been verified to the satisfaction of all, another is a slight shift in the dark lines seen in the spectrum obtained by passing sunlight through prisms, and, while the claims of various scientists to have found it are generally accepted, the quantities involved are so minute that it is hardly a satisfactory proof.

The third test involves a peculiarity in the motion of the planet Mercury around the sun, which does not approach closest to the sun at the same part of its orbit. The perihelion, the point at which it is nearest, advances from year to year, according to the theory of gravitation as propounded by Newton, but there has long been known a discrepancy of about 40 seconds of arc per year. According to Einstein there should be a difference of 43 seconds. As authorities differ on the actual amount of difference, Professor Silberstein pointed out that a number of observations of the planet are already recorded, and that if someone could be engaged to go over these, a new and accurate value of the change in the perihelion could be obtained, and the truth of the Einstein theory could be further verified or disproven.

ITEMS

TRANSPARENCY to infra-red light is the remarkable property discovered in bakelite, the American synthetic resin, now widely used for radio panels and phonograph records. The discovery was reported by M. Georges Kimpflin to the French Academy of Sciences. The transparency is not so high as that of window-glass with common white light, but still offers interesting possibilities of mechanical application.

Infra-red light is not visible to the human eye. Recently secret-signal systems have been developed for military use, based on infra-red radiation. It now appears possible to filter the light of the secret signal through bakelite so that the tell-tale visible rays are excluded. Furthermore, filtered infra-red rays are expected to have medical application in the practice of dermatology.

Bakelite may be doped with iron and certain other useful ingredients without seriously reducing its infra-red transparency. The new experiments recall the recent development in America of a black glass, impervious to common light, but transparent to ultra-violet light, the opposite extreme of the spectrum.

ELECTRICAL means for manufacturing carbon black, a widely used pigment, have been devised by the Bureau of Mines, U. S. Department of the Interior. Carbon black consists of exceedingly finely divided particles of carbon, and is at present produced by burning natural gas with an insufficient air supply, and permitting the flame to impinge on a cool metal surface. This method has been found strongly objectionable in many communities, and stringent ordinances have been passed to regulate its manufacture.

Inasmuch as carbon black is in great demand in the manufacture of printer's ink, shoe and stove blackings, phonograph records, black leather, typewriter ribbons, carbon paper and many other articles, a method for manufacture that does away with the objectionable though inevitable uncleanliness of the present process has been much desired. The Bureau of Mines process involves the use of high voltage discharges from electric arcs acting upon cheap light-oil distillates.

UTTER carelessness in the care of her children because she can always tell where they are is the chief characteristic of an Arabian water beetle described in a lecture by Major R. E. Cheeseman. Catching her husband unawares this militant female plants her eggs securely in the middle of his flat back where he can not knock them off. Then she goes on about her business. When the eggs hatch the young grow heavier and heavier until the poor husband beetle can hardly crawl along. The one observed by Major Cheeseman was a living baby carriage as he had no less than ninety babies firmly attached to his back.

LEARNING the relationships, ancient migrations, and original homes of animals by studying the parasites that infest them is the unique method of study employed by Professor Maynard M. Metcalf, chairman of the division of biology and agriculture of the National Research Council, who spoke before the American Society of Zoologists. Professor Metcalf chose as illustrative material the ''bell toads,'' an obscure and almost extinct group of amphibians, whose surviving members, however, are very widely distributed.

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SCIENCE NEWS

TELEGRAPHIC REPORTS TO THE DAILY PRESS ON THE WASHINGTON MEETING

BY DR. EDWIN E. SLOSSON

Director of Science Service

THE necessity for conserving our seemingly inexhaustible natural resources and making them last as long as possible through scientific research was the keynote of the address of the retiring president of the American Association for the Advancement of Science, Dr. Charles D. Walcott, secretary of the Smithsonian Institution. "The cream has been skimmed and all too often the milk has been thrown away," he said in stressing the fact that our natural wealth has been exploited in the past on the theory of making maximum profits for the exploiter. Dr. Walcott also condemned those whom he termed "sciosophists" and described them as "the apostles of organized ignorance who reject all evidence without attempting to prove or disprove and who condemn the exceptional mind that was compelled by an inner urge to attempt to penetrate into the mists that conceal the unknown."

As if in response to this indictment, a sharply worded resolution was passed by the American Association for University Professors meeting in conjunction with the American Association. "For any state to pass laws against the teaching of evolution is unconstitutional," the resolution stated, "as it is a direct infringement on free speech, based on groundless fear and ignorance." This is a protest against efforts in certain states to legislate the teaching of evolution out of university curriculums, and the dismissal of teachers for expressing their views on the subject. The association went on record as opposed to the determination of disputed questions of scientific fact by popular vote or by the activities of minority groups rather than by the teachers and investigators who have made specialities of their respective subjects. They advanced the argument that "if those who know most about a subject sometimes decide wrongly, matters are not likely to be mended by putting the decision into the hands of those who know less."

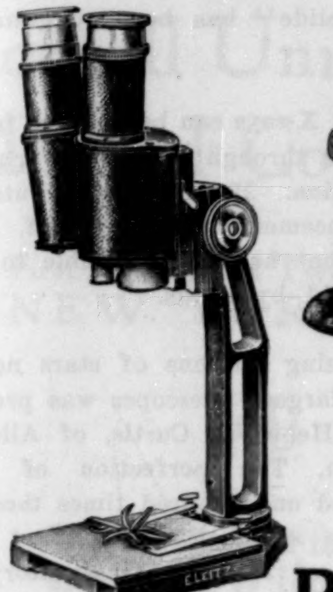
PROFESSOR BOAS denounced classification of immigrants according to "races" as meaningless from a biological standpoint. The notion that because a person is a Swede or an Italian he has certain racial characteristics shared by others of the same nationality, he declared, is entirely erroneous. All so-called "races" are extremely mixed people and the race must not be considered a unit but a conglomeration of many family groups. In designing tests for immigrants the fact that individuals in certain areas with the same language, customs, and habits act differently from those in other cultural areas must be taken into consideration. Before the validity of any test can be determined, he pointed out, there must be a thorough investigation of the degree of assimilation of immigrants from such regions at different periods after they are admitted.

Making immigrants pass tests for admission to the country just as prospective college students must take entrance examinations was proposed by Professor R. S. Woodworth, psychologist of the National Research Council.

A NEW ductless gland extract, taken from the parathyroid gland of the throat may prove to be a medical discovery of the same order of importance as insulin. Dr. J. B. Collip, of the University of Alberta, told of his researches on the control of calcium in the blood before the American Physiological Society. Previous workers had suspected that the parathyroid gland was the center of control of the calcium in the blood, for children with stunted parathyroids suffered from diseases due to lack of calcium, and calcium salts administered as medicine relieved them. Dr. Collip, however, has removed all doubt about the matter, for with a parathyroid extract which he has prepared he is able to cure the same diseases, and that without giving any additional calcium. "I am confident that I have located the active principle of this gland," said Dr. Collip. "Its effect on the human body is just as positive, and just as controllable, as is the effect of insulin."

A TREATMENT for angina pectoris, described at a meeting of the American Society for Pharmacology by Dr. D. E. Jackson, of the University of Cincinnati Medical College, promises to be more than a ray of hope for sufferers from this serious and frequently fatal disease of the heart. Administration of adrenalin by mouth forestalls the periodic pain without surgical measures and seems to effect a permanent cure. In any event no harm can result. At present, the cause of angina pectoris is unknown. It seizes its victims at periodic intervals with a violent pain in the region of the heart, which radiates down the left arm. Two treatments have been applied in the past. One, the more effective, requires the inhalation of amyl nitrite. When a sufferer breathes this easily vaporized liquid, a spasm subsides, but the same steps must be taken to subdue each of the frequent attacks, and the relief is in no sense permanent. Surgery has aided in the last few years, because it was found that if the cervical sympathetic nerves in the neck are removed, the pains may be stopped. Unfortunately, however, this measure is not always successful.

THOUSANDS of universes, each similar to the lens-shaped group of stars of which our sun is an insignificant member, with the nearest so distant that before it reaches us its light travels for a million years at a speed which would circle the earth seven times in a single second, have been shown to exist by Dr. Edwin P. Hubble, of the Mt. Wilson Observatory. His work, done with the great Mt. Wilson reflecting telescope, the largest in the world, was described to the American Association for



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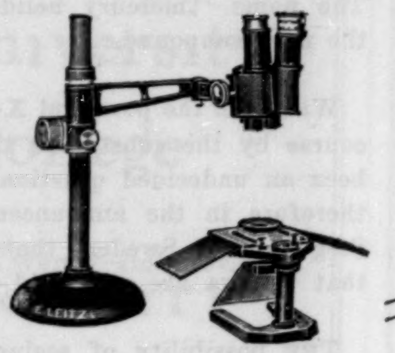

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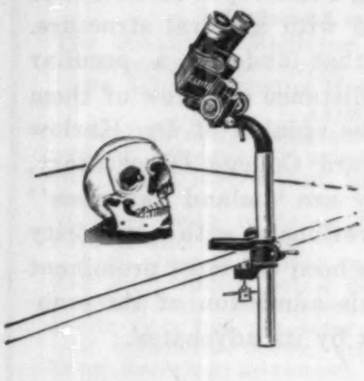

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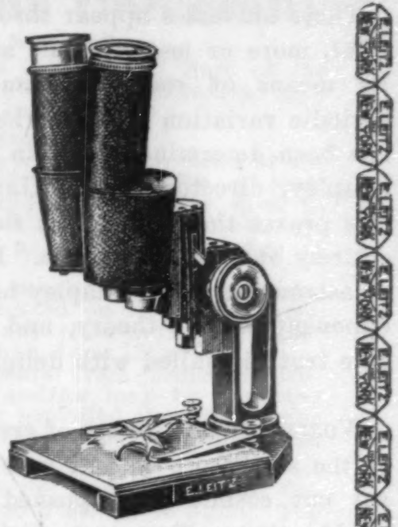

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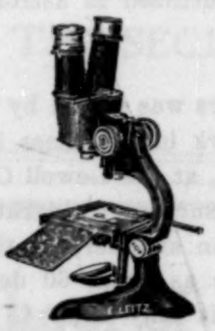

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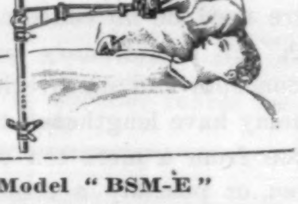

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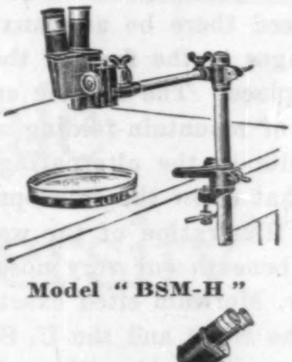

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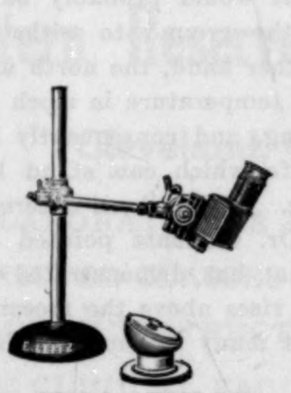

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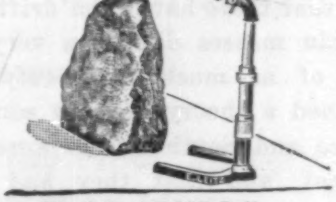

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the Advancement of Science by Professor Henry Harris Russell, of Princeton.

These universes appear through telescopes as clouds of light, more or less circular, and with a spiral structure. By means of stars in them that undergo a peculiar periodic variation in light, the distance of a few of them has been determined, and, in the opinion of Dr. Harlow Shapley, director of the Harvard College Observatory, this proves the theory that they are "island universes" entirely outside our system. Previously, with a majority of astronomers, Dr. Shapley has been the most prominent opponent of this theory, and his admission of its probable truth is hailed with delight by its advocates.

WORLDS in the process of creation in the lightless spaces of the sky where no star ever shines; worlds that are as yet but cosmic dust, pushed about by tides of light; worlds that will not come into being for trillions of years; worlds that will require almost endless time before they evolve life; microorganisms drifting about dormant in the awful cold of the space between the stars, waiting for a world on which they can settle. These were some of the fascinating speculations presented by Dr. J. C. Merriam, president of the Carnegie Institution of Washington, before the American Association for the Advancement of Science.

There need be no concern about there not being time enough for evolutionary processes, Dr. Merriam said. New concepts and discoveries in physics, chemistry and astronomy have lengthened the estimated life of a stellar universe from a mere ten or twenty million years to a hundred or possibly a thousand times that period.

Nor need there be any anxiety over there being too few changes in the face of the earth to allow evolution to take place. The flexible crust of the earth permits all sorts of mountain-folding and continent-making, and this results in the alternating isolation and mixing of species that allow the development of new life forms.

As an illustration of the way changes can take place literally beneath our very noses, in the apparently solid rocks, Dr. Merriam cited exact surveys made in California by the Navy and the U. S. Coast and Geodetic Survey. By comparison with earlier determinations, it was shown that there have been drifts in the position of solid mountain masses during a very brief period of thirty years, of as much as twenty-six feet. Dr. Merriam mentioned a theory held by some geologists that South America and South Africa were once parts of the same continent, and that they had literally drifted apart. He does not believe in the theory himself, he stated, but there can be no objection to it on the score of time, for the new physico-astronomical views allow time enough for the two continents to drift around the earth twice in opposite directions, passing each other on the way.

HELIUM, one of the most exclusive of all the chemical elements, has been made slightly more gregarious, by Professor Karl T. Compton, of Princeton, who has persuaded this inert light gas, first discovered in the sun and now used to float dirigibles, to combine with mercury. He explained to the chemists how the world's first helium compound was formed in a vacuum tube when mercury vapor was activated by ultra-violet light. The name "mercury helide" has been suggested for the new compound.

WHETHER the powerful X-rays can be diverted in their course by the substances through which they pass has been an undecided question. Physicists were interested therefore in the announcement made by Prof. Manne Siegbahn, of Sweden, that he has been able to prove that X-rays are refracted by solids.

THE possibility of seeing millions of stars now beyond the power of the largest telescopes was presented to astronomers by Dr. Heber D. Curtis, of Allegheny Observatory, Pittsburgh. The perfection of photographic plates with speed one hundred times those now in use would have the same practical effect as if the great 36″ telescope of the Lick Observatory were replaced with one with a lens 30 feet in diameter. There is also a great future in the use of the photo-electric cell, a device which measures small amounts of light by converting them into electric currents, and, he continued, "it will be very strange if the wonderful delicacy of the vacuum tube is not soon utilized in astronomical research."

THAT life is possible on Mars was stated by Dr. W. W. Coblentz, who told of his work last summer in conjunction with Dr. C. O. Lampland, at the Lowell Observatory in Arizona to determine the surface temperature of the ruddy planet. At noonday, in summer, on the equator, the temperature rises as high as 40 to 60 degrees Fahrenheit. During the night, it may drop to as low as 100 degrees below zero, so that if any life exists on this part of the planet, it would probably be capable of burrowing deep into the ground to withstand this nocturnal cold. On the other hand, the north and south poles, while the maximum temperature is much less, has a day 8 to 12 months long, and consequently it might be that some form of life which can stand low temperatures may exist there. While these determinations show low temperatures, Dr. Coblentz pointed out that his was the first work that has demonstrated that the Martian temperature ever rises above the freezing point of water, a condition that many astronomers have held impossible.

DO not wink when you are aiming a gun, if you want to hit the thing you are aiming at was the advice of Professor W. R. Miles, University of California, to members of the American Physiological Society. This is because every time you wink whether consciously or not, the eyeball itself shoots upwards with lightning speed, and the lids have a circular wiping movement which removes particles of grit and dust to the corner of the eye. Professor Miles discovered this eye-reflex while studying eye movements during the reading of Chinese written vertically and horizontally.

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SCIENCE NEWS

Science Service, Washington, D. C.

FUNCTION OF THE THYMUS GLAND

THE enigma of the thymus gland has been solved, or at least partly solved, by Dr. Oscar Riddle, of the department of genetics of the Carnegie Institution of Washington. The thymus is one of the ductless glands situated in the neck, and has long been a puzzle to physiologists, for its function has never been discovered.

Dr. Riddle has learned, however, by observing pigeons with diseased thymus glands, that these control the formation of egg shells, and have further effects on the reproductive processes. Pigeons with thymus glands removed by operation also produced shell-less eggs. Feeding the abnormal birds with thymus made them normal again, and they produced good eggs. Although he has not yet succeeded in isolating this eggshell-producing substance from the thymus, Dr. Riddle gives it a provisional name—"thymovidin."

Though this solves the riddle of the thymus as regards birds, it does not show that the gland has any direct usefulness for mammals, for this higher class of animals does not lay shelled eggs. Dr. Riddle seems inclined to regard the structure in mammals simply as a surviving ancestral organ. He reasons: "Though not necessary to the life of the individual, thymovidin would seem essential to the perpetuation of those vertebrate species whose eggs are protected by egg-envelopes. Such animals were the ancestors of mammals, and thus mammals also probably could not have come into existence without the thymus."

THE PRODUCTION OF MALE CHARACTERISTICS IN FEMALE CHICKENS

TAKE the female sex glands from a hen and you take away her feminine nature. Hens that fight, crow and in other ways behave like roosters have been produced in the laboratory of Professor Frank R. Lillie, of the University of Chicago, by a simple gland-removing operation.

L. V. Domm, of the university, reporting on the work, says: "The larger percentage of our birds have assumed additional male characters following removal of the ovaries until they are practically complete replicas of the male, and, to those not familiar with their history, they are regarded as unmistakable males. Thus we find that they assume the complete male plumage, spurs grow as they do in the normal cock, head furnishings increase in size until they can not be distinguished from those of the normal male.

"Other birds in the pen regard them as males and when a strange cock is introduced they fight as would other cocks, very frequently assuming the initiative, some of them having been observed to come off victorious in such a combat. Many of these birds crow regularly. When aroused by a disturbance, it was found that their reaction is very similar to that of the male; the sounds they make, together with their reaction on such occasions, reminds one very much of the young male just prior to maturity.

"One set of experiments may be mentioned as an example: Out of one lot of fourteen females of the same hatch, one was kept as control and thirteen were operated upon between the ages of six weeks and six months; twelve of these have developed all the characteristics of the male mentioned above, some being completely cock-feathered, while the others are fast becoming so. The other one of the thirteen is very capon-like in appearance except perhaps for size and can not be readily distinguished from her capon brothers by those not knowing her history. This bird has assumed complete male plumage, is developing spurs; but the comb, wattles and earlobes are pale and small, resembling those of the capon.

"In some of our cases individuals which have assumed more or less complete male characters as concerns head furnishings, plumage and spurs, are reverting toward the female type as shown by the female type of plumage reappearing.

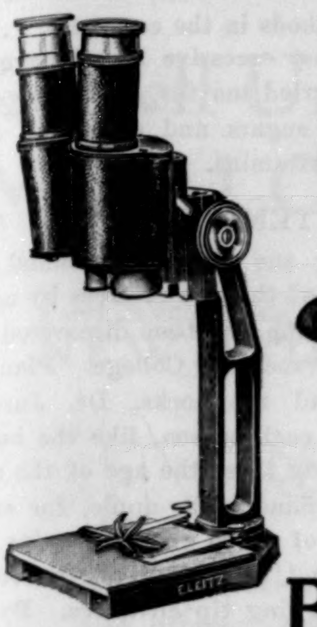
"Our results indicate that the female in the brown leghorn fowl has many potentialities of the male, which are normally inhibited by the presence of the ovary, and that these potentialities can assert themselves approximately fully after the complete removal of the ovary at an early age."

THE ETIOLOGY OF HEMACHROMATOSIS

COPPER, dissolved from the "worm" of the still during the making of liquor, is a cause of the disease popularly called "hardening of the liver," rather than the liquor itself, Dr. Frank Burr Mallory, of the Boston City Hospital, has announced to the medical profession. Copper in foods prepared in copper vessels or colored green with copper salts can produce the same malady. Chronic copper poisoning is a more common disease than has been thought, he says, for in 3.4 per cent. of a large group of post-mortem examinations he has found evidences of its harmful action.

Copper starts the poisoning of the system by causing the red coloring matter of the blood to decompose, forming a yellow pigment. This condition of the blood Dr. Mallory calls "hemachromatosis." The yellow pigment accumulates first in the liver, but when the liver becomes overloaded it gathers also in the pancreas, kidneys, lymph nodes, heart, thyroid and adrenal glands, and the skin of the hands and feet.

In the liver the cells where the pigment accumulates sicken and die. New cells grow, but the tissue thus formed is more like tumorous growth than healthy liver cells. Hardening of the liver follows. Accumulation of the poisonous pigment in the pancreas causes a breakdown of the tissue, followed by diabetes. When the adrenal cortex is attacked, abnormal darkening of the skin follows. So far as Dr. Mallory has observed, the



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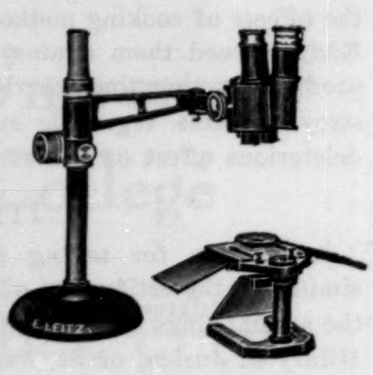

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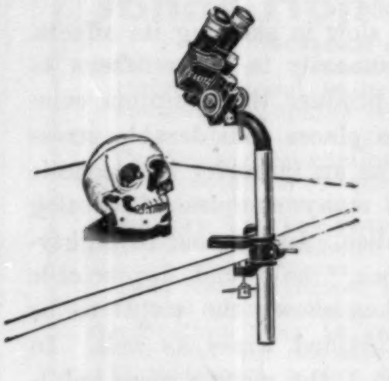

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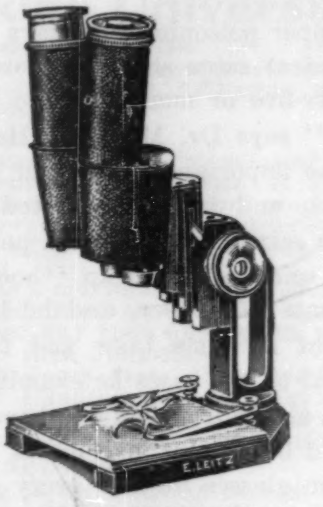

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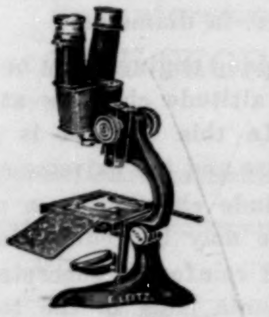

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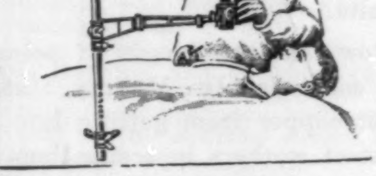

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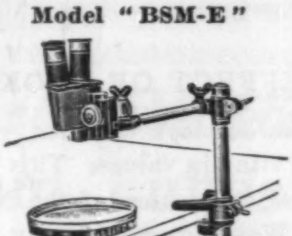

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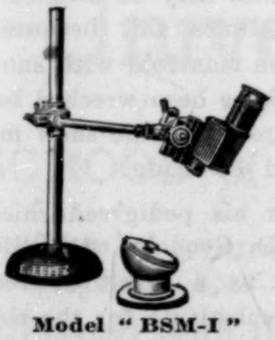

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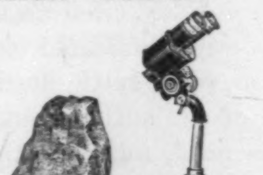

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kidneys are able to repair successfully whatever mischief is done there. The liver, however, is always the first organ to suffer.

Copper poisoning is always slow in showing its effects. ''Clinical cases show that ordinarily it takes fifteen to twenty-five or more years to produce the symptom complex,'' says Dr. Mallory. He places considerable stress on the importance of copper as an impurity in alcoholic drinks, and has investigated many samples of bootleg liquor seized by the Boston police. In nine out of eighty-four seizures of cheap ''hooch'' he found appreciable amounts of copper, and he has shown the metal to be present in home brew and fortified wines as well. In several of the cases he examined, the victims were habitually alcoholic. One of them, an ex-bartender who had turned bootlegger, had drunk a pint of whiskey and four or five glasses of beer every day for many years.

Copper poisoning as the result of inhaling or swallowing copper dust is also suggested. Three or four of the cases were men who had worked in machine shops where copper filings and dust were produced in quantity, and at least one of them was not a drinking man. Finally, Dr. Mallory suggests that poisoning may result from the eating of foods prepared or kept in copper vessels, or canned foods, like peas and pickles, colored green with copper salts.

''Now that the danger of poisoning has been pointed out,'' concluded Dr. Mallory, ''steps should be taken to prevent copper from getting into liquors and foods, and to protect workers in occupations involving copper from inhaling or ingesting copper dust.''

THE EFFECT OF COOKING ON VITAMINS

COOKING destroys vitamins, yet cooked foods may have adequate vitamin values. This paradox was stated before the annual convention of the National Canners' Association, at Washington, recently, by Professor Walter H. Eddy, of Columbia University, a widely-known specialist on the subject of vitamins.

Professor Eddy cited as an example the studies some years ago which indicated that ordinary cooking temperatures in an open kettle destroyed as much as ninety-five per cent. of the anti-scorbutic vitamin, or vitamin ''C.'' It was assumed, following these experiments, that cooked vegetables were entirely useless as means of preventing scurvy and similar deficiency diseases. However, a test was later determined upon, and increased quantities of the cooked foods were fed to experimental guinea-pigs. It was discovered that even the small fraction of vitamin remaining in the cooked vegetables was sufficient to have the desired effect in the prevention of disease. This depends on the fact that vitamins are very powerful substances, and a little goes a long way.

Further experiments with foods cooked in sealed containers under pressure, with air excluded, showed that the vitamin content was impaired much less than it was in open kettle cooking. The delegates to the convention received this statement with interested comment, for canned vegetables are cooked under pressure. Professor Eddy stated that the cooking conducted in his laboratory was done in pressure cookers similar to those now used extensively in home canning.

Though he encouraged his audience in the matter of the effects of cooking methods in the canneries, Professor Eddy warned them against excessive blanching of their products, saying that, carried too far, such processes destroy valuable vegetable sugars and salts, and have a deleterious effect on the vitamins.

ITEMS

A METHOD for telling the age of perennial plants similar to the estimation of the age of trees by counting the annual rings on the stump, has been discovered by Dr. Hilary S. Jurica, of St. Procopius College. Plants with rhizomes, or underground rootstocks, Dr. Jurica explained, leave bud scars each season, like the bud-scars on twigs, and by examining these the age of the rhizome may be learned. The common May-apple, for example, after it reaches the age of seven years, remains always seven years old, for the ''old end'' of the rootstock decays as fast as the growing tip advances. By means of these steadily advancing rootstocks, perennial plants frequently come to dominate great patches of ground, and what may appear to be a whole colony of plants, comprising hundreds of stems, will prove upon digging up to be a single interconnected mat or web—a single plant twenty or thirty feet in diameter.

ALTITUDE tests for airplane engines may be carried on at sea level in the new altitude chamber at the U. S. Bureau of Standards. In this room it is possible to get the reduced air pressure and the extreme cold of very great heights. The altitude chamber is a small room in which the air pressure may be reduced as much as desired. The walls are of reinforced concrete about sixteen inches thick. Ammonia coils in the top serve to lower the temperature. The temperature of air entering the carburetor can be regulated separately from that in the room. In this way, without any risk of life, the causes for failures of engines may be studied. In the test chamber motors sometimes fail because of the moisture clogging the intake manifold with snow. It is believed that many planes have been wrecked because of this, but it could not be proved as the snow melted before an investigation could be made.

A SPECIAL sun-porch for his pedigreed chickens has been described by Dr. H. D. Goodale, of Williamstown, Mass. It has been built as a result of recent discoveries that sunlight is a substitute for the rickets-preventing vitamin, necessary for good health and normal growth in animals as well as human beings, and that it also has an effect on egg production. Dr. Goodale has divided his experiment into three sections, in each of which 96 hens are used. One lot is kept under ordinary chicken-farm conditions; a second is exposed to the light of mercury vapor lamps for an hour each day, to give them an extra dose of ultra-violet light; the third group is kept in a special pen with a sliding glass roof that can be pushed out of the way in fair weather and used to shelter the hens and their food when rain threatens. In this way the third group is given the advantage of every possible minute of sunlight.

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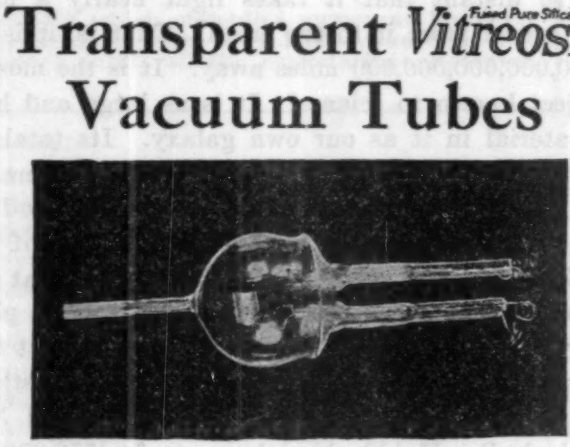

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SCIENCE NEWS

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NEW STELLAR SYSTEMS

THE limits of the universe have been pushed outward and great stellar systems comparable to our own tremendous galaxy are shown to exist by the astronomical research of Dr. Edwin Hubble that won for him half of the $1,000 prize for the best paper before the American Association for the Advancement of Science.

Using the largest telescope in the world, the 100-inch reflector at the Mount Wilson Observatory of the Carnegie Institution at Pasadena, California, Dr. Hubble has solved the mystery of the great heavenly objects that look like pinwheels in the sky, the spiral nebulae.

Nearly overhead in the sky at the present time, in the constellation of Andromeda, there is the most famous of these spirals, the Great Nebula of Andromeda. To our eyes, viewing it from the earth, it has several times the area of the full moon, although it is so faint that good sight is required to spot it in the heavens.

In small telescopes it looks merely like a cloud of matter, but when Dr. Hubble turned the great Mt. Wilson 100-inch telescope upon it, he found that the outer ends of the spiral contain immense numbers of very faint stars, a hundred thousand to a million times fainter than the stars that the naked eye can see.

A study of such photographs and the application of known astronomical laws led Dr. Hubble to the following facts about the Andromeda nebula:

It is so distant that it takes light nearly a million years to travel from it to the earth. That is, it is some 6,000,000,000,000,000,000 miles away. It is the most distant object known to science. It is as large and has as much material in it as our own galaxy. Its total light is one billion times that of the sun. It contains some three or four thousand million stars. In shape and form it is not unlike the great stellar system or galaxy of which the Milky Way and most of the stars we see at night are a part and in which the sun and its revolving planets are but pin points. It is at four times as great a distance as ever previously established for any celestial object, with the exception of the faint star cloud N.G.C. 6,822 which Dr. Hubble has shown to be 750,000 light years from the earth. It is an "island universe," a concentration of stars, gaseous material and perhaps even planets, out in the space of the great all-inclusive or super-universe and billions of miles away from other universes or galaxies like our own. And the spiral in the constellation Triangulum seems to be nearly a twin to that in Andromeda.

How can evidence of such gigantic "universes" be obtained? First of all Dr. Hubble's photographs, better than any previously obtained, showed "dense swarms of actual stars" in the outer parts of spiral nebulae. Then it was found, by taking photographs night after night, that some of these stars were what is called Cepheid variables. They fluctuate in brightness, going through a period of sudden rise to brilliance and slow fall to dimness in times ranging from a few hours to 50 days. At maximum they range from 4,000 to 8,000 times the sun's brightness. This was the clue to the determination of the great distance of the nebulae.

Some years ago Dr. Harlow Shapley, of Harvard, worked out a useful relationship between star brilliance and the period of these Cepheid variables, so named because they are most prevalent in the constellation of Cepheus. He found that if the period of variation was known, the absolute brightness, dependent only upon the temperature of the star and not upon its distance from the earth, could be determined. A simple comparison of absolute brightness of the star with the brightness shown through the telescope tells the distance of the star from the earth.

When Dr. Hubble applied this law to the variable stars he discovered in the Andromeda nebula, he found that they were all about 930,000 light years away in another island universe.

While Dr. Hubble is the first man to prove the distant existence of such vast conglomerations of matter outside our own locality of space, their character has been suspected for about a century. Sir William Herschel, English astronomer of 100 to 125 years ago, when he saw the spiral nebulae poetically called them "island universes." The name persisted and now Dr. Hubble has given it justification.

Undoubtedly more distant spiral nebulae, now known to be stellar galaxies, lie even farther out in space. There are more than 100,000 of these spirals known to astronomers and most of them, instead of being great patches of light like the one in Andromeda, appear merely as points of light in telescopes and on photographs.

Imagination totters when it attempts to conceive of the distances that must intervene between these galaxies or "universes" and our own.

Space, or the super-universe, with the aid of Hubble, Einstein and other scientists, has been swollen enormously in the past few years.

NEW METHODS OF KILLING PROTOZOA IN THE DIGESTIVE TRACT

KILLING of the thousands of minute animals that inhabit termites or "white ants" and digest their woody food for them may seem an unimportant accomplishment. Yet this is what won Dr. L. R. Cleveland, National Research Council fellow working at the Johns Hopkins University, Baltimore, half of the annual prize of the American Association for the Advancement of Science.

The microscopic protozoa that live in the digestive tracts and blood systems of man, animals and insects are mostly harmless or helpful, yet there are some that cause serious diseases like malaria, sleeping sickness and dysentery. The importance of Dr. Cleveland's success in killing the protozoa of termites without hurting their involuntary hosts lies not in the practical application of

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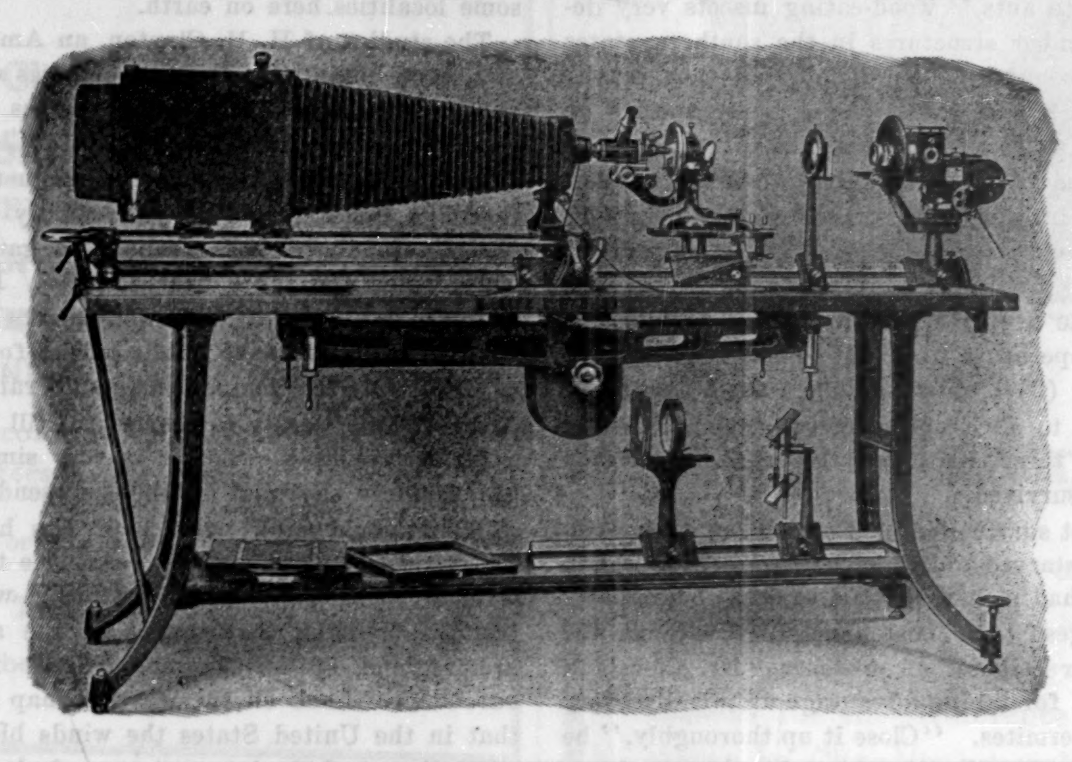

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this one accomplishment, although the method may be used in destroying troublesome "white ants," but in the promise of new biological and medical methods that it contains. His new technic has possibilities of application in widely different fields ranging from the cure of disease to the protection of property.

Dr. Cleveland's studies began about five years ago, on the protozoa that inhabit the digestive systems of termites, or "white ants," wood-eating insects very destructive to all timber structures in the southern states and in all warm countries. He found that they played a very important rôle in the lives of most species of these insects. In some termites half the body weight is made up of swarms of protozoa. Dr. Cleveland, wondering whether these internal guests might not be necessary to the termites, sought for methods to kill them without killing the hosts. He found that this could be accomplished in any one of three ways: (1) By keeping his termites at a temperature of about 95 degrees Fahrenheit for 24 hours; (2) by starving them for a time; (3) by exposing them to air or pure oxygen under pressure. Under any one of these treatments the protozoa perished and the termites survived.

But they did not survive long. Deprived of their "inhabitants," they starved to death in three or four weeks, even though they had plenty of wood to eat. Apparently they can not digest their customary diet without the assistance of their colonies of protozoa. Dr. Cleveland suggests a method for taking advantage of this discovery to rid a house of termites. "Close it up thoroughly," he says, "Cut off the termites' retreat through the basement to the ground. Fire the furnace to the limit, until you get a temperature of 95 degrees or higher. Keep it that way until you are sure the walls have been heated through for twenty-four hours. Or if you can get a temperature of 110 degrees or more, a much shorter period should suffice. With their protozoa dead, the termites should die of starvation in the midst of plenty."

More important, however, in Dr. Cleveland's opinion are the possible uses of his discovery in promoting health, through adaptations of his methods of killing protozoa with oxygen. He found that if pure oxygen were substituted for air at ordinary atmospheric pressure or, what amounts to the same thing, if air, with its twenty per cent. content of oxygen, were supplied at five times the usual pressure, the protozoa in the bodies of termites could in some cases be killed in a relatively short time, while the insects could stand the treatment for long periods—in some cases indefinitely. When pure oxygen was applied under pressure, the protozoa died even more quickly and there was less risk to the host animal. Cold-blooded vertebrates like frogs also survived this treatment, but success has not yet been attained with warm-blooded animals. Dr. Cleveland is now contemplating further experiments on rats in an endeavor to find and eliminate the causes of failure.

For more immediate results, Dr. Cleveland, in a second series of experiments on the warm-blooded animals, is searching for a chemical that will release oxygen to kill the internal protozoa without injuring the body tissues. He has had partial success with those already tried, and is now awaiting the arrival from Germany of a new compound which is claimed to be particularly efficient.

THE SUN AND THE WEATHER

THERE seems to be evidence to show that very moderate changes in the sun's heat, without much affecting the average temperature of the world as a whole, may yet make the difference between prosperity and failure in some localities here on earth.

The studies of H. H. Clayton, an American meteorologist, show plainly that major changes of the barometer and temperature in the United States come from solar variations. About 10 years ago Mr. Clayton, then chief forecaster for the Argentine government, began a long thorough investigation of just exactly what happens to barometers, thermometers and rain gauges all over the world when the sun's heat changes. By 1920, he was actually employing solar measurements of the Smithsonian Institution to make public official forecasts a week in advance for the temperature and rainfall of Buenos Aires. These weekly forecasts are still maintained.

At first sight the matter is very simple. You would all probably say that if the sun sends more heat the weather would grow warmer, if less heat, cooler. But the subject is more complex. A place tends to be warm or cold according as its prevailing winds come from tropical or polar directions. In the atmosphere there are regions of low barometer and regions of high barometer. Look on the weather map and you will see that in the United States the winds blow counter-clockwise all around the low centers, and clockwise all around the high centers. Meteorologists call these effects cyclones and anti-cyclones.

If now the system of cyclones and anti-cyclones is shifted north, south, east or west by any cause, there will be a change of wind and consequently a change of temperature. Rainfall also is modified. According to Mr. Clayton's researches this is exactly what happens when the sun's heat changes. The barometric highs and lows move a few hundred miles and alter the wind directions, and with them the weather.

Data for stations all over the world and for all seasons of many years must be compared with recorded solar changes before meteorologists will be able to begin predicting from the state of the sun's heat. This great work is only begun. That is why our Weather Bureau does not use these methods for forecasting.

The part of the Smithsonian Institution in this new movement is to secure regularly accurate measurements of changes in the sun's heat. We began to make these studies over 20 years ago in Washington, but soon found it necessary to move to clearer skies. We discovered that the sun's heat varies and after years of research that took us to three continents we established in 1918 an observatory in the Nitrate Desert of Chile where it almost never rains and where there is neither animal, insect, reptile nor vegetable life and where all water and supplies must be hauled many miles. From this observatory nearly 10,000 feet above sea-level, and at another station on a mountain in Arizona, over a mile high, daily solar observations are made and daily tele-

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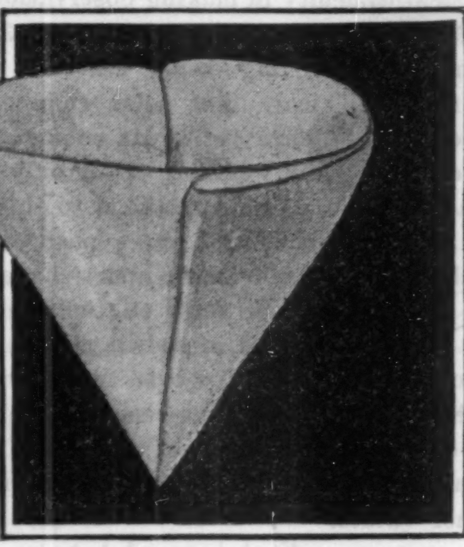

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graphic reports are sent to the Smithsonian Institution.

There is great difficulty in making observations accurate enough. The sun's changes seldom exceed 3 per cent., though sometimes reaching 5 per cent. or more. Mr. Clayton's results indicate that solar changes as small as 1 per cent. or less are yet great enough to produce noticeable effects on the weather. It is only lately that we have succeeded in refining methods to this degree of accuracy. But for about two years past our two stations, which lie over 4,000 miles apart, have agreed to about one half of one per cent. on the average of all good days, and have agreed in showing solar changes of from one to five per cent. For over two years they have indicated that the sun's heat has been generally from one to two per cent. below normal, but at present it is nearly up to normal again, and apparently seems marching towards higher values.

Between summer and winter and between night and day, enormously greater changes than three or five per cent. occur and we adjust ourselves to them. Why should we consider such seemingly small changes in the sun's heat?

The answer is that the food plants, the great cities and others of the most important things in the world are found exactly where they are because they are all adjusted to exactly the climatic conditions which prevail. And those adjustments are apparently very capricious. Why do palms grow in southern England, which lies as far north as our bleak Labrador coast, for instance, and why do people winter in south France, as far north as Ottawa, while in America people go to Florida or southern California to get mild winters?

The point is that a little change in the quantity of solar heating might alter the distribution of heat over the earth in such a way as to produce perfectly astounding changes. One per cent. change of the heat available to warm the air over the enormous area of the tropics may be of little effect there but may easily produce very much larger effects towards the poles. For the areas of the zones grow less towards the poles. It is like the tides. On the open oceans they oscillate only a foot or two, but in the confined Bay of Fundy the tidal wave is over 40 feet high.

One looks forward to a time when daily telegrams shall come to a central station from at least four solar radiation observatories instead of from two as now, and the condition of the sun shall be broadcasted for the use of meteorologists the world over. For, after all, the temperature and all life on the earth depends on the sun's rays. They ought to be thoroughly investigated so that we may be informed in advance what we are to expect as the consequences of changes in the sun.—*Charles Greeley Abbot.*

THE USE OF HYDROGEN PEROXIDE IN DETERMINING FERTILITY OF SOILS

Fertilizer needs of any soil can be learned in two days with almost no expense, instead of requiring a couple of years of costly field tests, by a new method devised by M. D. Chonchack, a French agricultural scientist.

M. Chonchack's system depends on two facts that have been known for a long time as matters of pure science, but were never thought of as possibilities in economic application. It is well known that the fertility of the soil depends on the activity of the microscopic organisms it contains, largely bacteria and fungi. It is also well known that the mineral salt requirements of these bacteria are about the same as those for the higher plants that make up our crops. Therefore, reasoned M. Chonchack, a soil that harbors a rich growth of bacteria will produce a good harvest.

A difficulty arose in the matter of determining the bacterial content of the soil, for methods of direct counting under a microscope are difficult and inaccurate. Here again M. Chonchack made use of the fact, well known to every one who has ever used hydrogen peroxide as a mouth wash or as an antiseptic on a scratch, that bacteria cause this chemical to give off oxygen. The amount of oxygen given off is always in proportion to the total quantity of bacteria present. Therefore, by treating his soil samples with hydrogen peroxide and measuring the oxygen that bubbles out, M. Chonchack was able to get a measure of the bacterial life present.

Preliminary tests have shown that the method holds good within certain limits in determining the fertility of soils, and more extended investigations are planned for the coming season.

ITEMS

A point which will change, on being heated, from brilliant red to black has been prepared by Henry A. Gardner, Washington chemist, for use on automobile radiator caps. When the water in the radiator starts to boil the cap changes first to maroon and then to black. When the engine is running normally again the pigment returns to bright red. The paint is a combination of metallic iodides. The cap may be made to change color at least fifty times before it shows any sign of losing its original red.

Colored pictures with only one exposure of the object are possible by means of a new German invention told of by the Berlin correspondent of the *Journal of Industrial and Engineering Chemistry*. Instead of using three exposures of the same object with red, yellow and blue filters the same effect is possible by exposing three negatives at the same time with a system of mirrors to reflect the image. The different colored filters are used in front of the negatives and the whole is projected upon specially prepared gelatin paper. A naturally colored print resembling a good three-color print results. The process is equally successful in portraits, interior views or landscapes.

An observatory for avalanches, believed to be the first of its kind, has been erected in Tamischbachturm in the province of Steiermark, Austria, by the state railway. Its object is both scientific and practical. It has been fitted with instruments for the recording of exact data, and it will also send out warnings to stations below when avalanches threaten. It is also planned to "set off" incipient avalanches and so prevent them from launching themselves later spontaneously and without warning.

JUST PUBLISHED

JACKSON--The Effects of Inanition and Malnutrition upon Growth and Structure

By C. M. JACKSON, M.S., M.D., LL.D.,
Professor and Director of the Department of Anatomy,
University of Minnesota

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THIS book presents a systematic review of the subject, giving the results of the investigations of the author and his co-workers together with a comprehensive discussion of the widely scattered data in the literature concerning the morphological effects of inanition in all living organisms. It has a special appeal and proves very useful in many fields of scientific procedure: to *Biologists* who are concerned with the fundamental characters of living organisms; to *Anatomists* who are interested in the problems of morphogenesis; to *Physiologists* and *Biochemists* working in the various fields of human and animal nutrition, since inanition is one of the primary factors in pathogenesis; and to *Physicians.*

The subject is treated in two general sections: Part I has to do with Plants and Invertebrates, and includes a chapter on the Effects of Inanition on Plants, pointing out modifications in size, structure and sex, and discussing questions of deficiencies. The chapter following on the Effects on the Protozoa is of special importance, since the changes in cell, size, form, endoplasm, reproduction and recovery upon refeeding help the biologist to interpret the effects of inanition in the higher forms, including man. The chapter on the various phyla of the Higher Invertebrates gives interesting and valuable information with regard to weight and regeneration during inanition.

Part II is concerned with the effects of inanition upon vertebrates including man. The general effects upon the body as a whole are considered first, followed by chapters upon the various systems and organs of the vertebrate body. In general each organ or part is considered in relation to the effects of total inanition or the various forms of partial inanition (deficiencies in protein, salts, vitamines, etc.).

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SCIENCE NEWS

Science Service, Washington, D. C.

SUN SPOTS AND ANIMAL LIFE

PERIODIC increases in the numbers of certain animals are blamed on the sun and its spots by C. S. Elton, of the department of zoology and comparative anatomy of the University of Oxford. Extraordinary as this conclusion may seem, Mr. Elton offers scientific data to show that animal populations are influenced by the well known sun spot cycle.

By methods of mathematical analysis it is possible to recognize definite climatic cycles, he says, even in a country with a variable climate. In seeking the causes of these variations it is reasonable to look to the sun, the source of practically all our energy. For over one hundred and fifty years records have been kept of the number of sun spots. These increase to a maximum about every eleven years. Increase in the number of sun spots is accompanied by an increased output of energy by the sun, and, strange to say, by a low temperature on the earth. Further, the average annual temperature of the whole earth, the atmospheric pressures and rainfalls of various parts of the earth, the tracks of storms in North America and the rate of growth of the redwood tree, have all been found to show marked eleven-year fluctuations which correspond to those of sun spot numbers. There are natural records in the case of the redwood dating back in many cases three or four thousand years.

Turning now to variations in the numbers of animals, if the return of rabbit skins taken by the Hudson Bay Company be consulted, the interesting fact is established that the numbers increase to a maximum every eleven years, and that each maximum corresponds to a sun spot minimum. The fur returns of this company, which have been kept since 1845, give a good index of the total rabbit population, hence the conclusion is reached that variation in the number of sun spots in some way affects the rate of reproduction of rabbits.

Biologists can not yet explain this extraordinary relationship but it seems likely that the explanation will be found in the effect of sunlight on animals, both directly and indirectly, through their food. It is common knowledge now that the antirachitic vitamin is intimately related to sunshine.

The lynx and the fox feed on the rabbit, so it is not surprising that the numbers of these animals, too, vary in well marked eleven-year periods.

Another interesting little animal in this connection is the lemming, which lives in the Arctic regions. Periodically it attains vast numbers and it migrates usually from the mountains to the lowlands, often even into the sea. Such migrations occur contemporaneously throughout Norway, Sweden and northern Canada and probably throughout the whole Arctic regions.

"The spectacle of processions of lemmings ecstatically throwing themselves over the ends of railway bridges, and falling to an apparently useless death beneath; the sea strewn with dead lemmings like leaves on the ground after a storm; lemmings making a beeline across crowded traffic oblivious to danger; all these things are bound to make people talk," Mr. Elton says. "The lemming-years are such conspicuous phenomena that it is safe to assume that all which have occurred since about 1860 have been recorded. Lemming-years in Norway have the status of great floods."

By studying their records it is found that their frequency is about three and one-half years, not eleven years as in the case of rabbits. Close examination of meteorological data shows that climate too fluctuates in three and one-half year periods, particularly in Arctic regions. The cause of this short period fluctuation is not known.

In the same way as the fox and lynx benefit by years of large rabbit numbers, so in lemming-years large numbers of short-eared owls collect to feed on them, and peregrine falcons, which in normal years do not visit Norway, collect in large numbers to feed on the owls. In Greenland Arctic foxes tire of ptarmigan in lemming-years and so allow it to breed and attain large numbers in the year following the lemming-year. Then the Arctic fox decides that he likes ptarmigan after all and down go the ptarmigan numbers.

NAVY ASTRONOMERS TO OBSERVE ECLIPSE IN SUMATRA

IT is gratifying to American astronomers and others interested in the progress of science to know that the United States Naval Observatory will carry on in the observation of total eclipses of the sun by sending an expedition to Sumatra to observe the total eclipse of January 14, 1926.

Through the unique opportunities that it possesses as a government institution under the control of the Navy Department it is possible for the United States Naval Observatory to advance the cause of astronomical science in some ways that are not within the reach of private institutions. This was evidenced in the sending forth of special time signals for the convenience of eclipse observers on the occasion of the last eclipse and in the pioneer work in the observation of the eclipse from the Navy dirigible, *Los Angeles*, by a group of scientists from the observatory under the head of Captain Edwin T. Pollock, superintendent of the Naval Observatory.

The interest shown by the present superintendent in promoting eclipse observations speaks well for the success of the eclipse expedition that will be sent forth from our national observatory before the year is over, the sixth to be equipped by this observatory since the year 1900. It is also in keeping with the traditions of the Navy. Many astronomers of to-day recall the enthusiastic interest in the cause of astronomical research evidenced by Rear-Admiral Colby M. Chester, superin-

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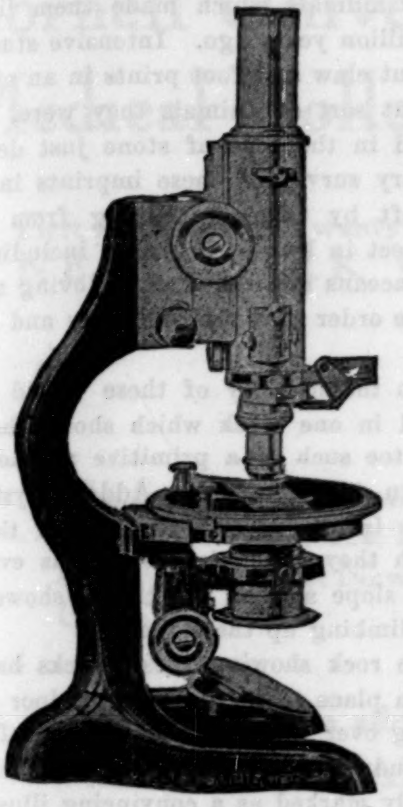

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tendent of the Naval Observatory in 1905, who headed an expedition sent out by this observatory to Africa and Spain to observe the eclipse of August 30, 1905, when a special line squadron of three vessels was detailed by the Navy Department for the observation of the eclipse and a special appropriation of $5,000 was granted by Congress.

An interesting report of the results of the observation of this eclipse and of the eclipse of June 8, 1918, as well as notes of aviators on the eclipse of September 10, 1923, are contained in the Publications of the U. S. Naval Observatory, Second Series, Vol. X, Part II—Appendix, which has just recently come from the press. There are some remarkably fine plates in this volume, photographs of corona and prominences, and drawings from negatives, in addition to the scientific discussion of the observations of these eclipses. The frontispiece is a reproduction in color of the painting of the corona of the eclipse of June 8, 1918, by the artist, Howard Russell Butler, who was a member of the Naval Observatory eclipse expedition to Baker, Oregon. There is also a reproduction in color of a painting by the same artist of the approach of the moon's shadow and of details in the structure of the prominences.

An earlier volume of the Publications of the U. S. Naval Observatory, published in 1905, dealt with the results of the observations of the eclipses of May 28, 1900 and May 17, 1901, the former in North Carolina and Georgia and the latter in Sumatra. Both volumes are valuable contributions to the published records of eclipse observations. They will be followed by another volume dealing with the results of the observations of the eclipse of January 24, 1925 and January 14, 1926.

The eclipse of next January will be a fine one of four minutes duration in the Indian Ocean and over three minutes duration in Sumatra, where it will occur in the afternoon. This eclipse will also be visible later in the afternoon and with shorter duration in Borneo and the island of Mindanao in the Philippines. It will occur on the east African coast near the equator shortly after sunrise. If present plans are carried out there will be at least one other eclipse expedition sent out from the United States to observe this eclipse, the Sproul Observatory expedition from Swarthmore College. This institution, whose department of astronomy is under the direction of Dr. John A. Miller, has been particularly active in observing recent eclipses. English, French and German observatories also are now planning to send expeditions.—*Isabel M. Lewis.*

NEWLY DISCOVERED PREHISTORIC FOOTPRINTS

MYSTERIOUS tracks of strange fossil animals discovered in primitive rocks 950 feet below the top of the Grand Canyon of the Colorado, have been brought to Washington for identification by Dr. C. W. Gilmore, paleontologist of the U. S. National Museum. These creatures left their footprints in the sands millions of years before the huge reptilian dinosaurs began to splash through the swamps then in that region.

The tracks were discovered crossing the mule path of the Hermit trail that takes venturesome tourists from the rim to the bottom of the canyon. From the Permian geological strata in which they were found, Dr. Gilmore estimates that the animals which made them lived at least twenty-five million years ago. Intensive study will be made of the faint claw and foot prints in an effort to determine just what sort of animals they were. Many tracks are included in the tons of stone just delivered here. A preliminary survey of these imprints indicates that they were left by animals ranging from a few inches up to five feet in length, probably including amphibians and crustaceans and other water-loving animals of a more primitive order that the dinosaurs and similar reptiles.

The only clue to the identity of these varied animal tracks is contained in one track which shows the mark of a rounded flat toe such as a primitive reptile called Diadectes is known to have had. Added mystery is given these marks in the stone by the fact that the formation in which they were discovered was evidently once a wet, sandy slope and all the tracks showed that the animals were climbing up the slope.

A section of the rock showing these tracks has been exposed and left in place to serve as an outdoor exhibit for tourists passing over the trail. As soon as Dr. Gilmore is able to study out and identify the tracks, the spot will be fittingly marked as a convincing illustration of the upward climb of life on earth. Dr. Gilmore said: "When even the most skeptical see these marks in the layer of stone 950 feet below the present rim of the canyon, they begin to realize the vast period of time which must have elapsed since these primitive animals lived."

SUBSTITUTES FOR MOTOR FUEL IN SWEDEN

GASOLINE costs are sky-high in Sweden, and Swedish inventors are busy on devices to make motor operation possible without it. One that has been patented makes use of gas generated from charcoal, and two others use crude oil.

The charcoal-gas generator is an interesting device. A chamber lined with fireclay is filled with charcoal, which is heated to incandescence by its own combustion. Steam is then drawn through the glowing coals, resulting in the formation of a mixture of carbon monoxide and hydrogen, both of which have high fuel value. After being filtered and purified, they are fed into the engine. The inventor claims that no change is needed in the carburetor, and that the engine can use gasoline or charcoal gas alternately without trouble. He states that the weight of charcoal fuel necessary for operation is greater than that of the gasoline formerly carried, but that its cost is only one fourth as great.

A similar reduction in the cost of operating an automobile is claimed by the Swedish inventor, Nils Anderson, for his device which permits the combustion of crude oil in an ordinary gasoline motor. The basic difficulty

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which Anderson had to overcome was the fact that crude oil can not be completely vaporized by ordinary heating, but leaves a residue which will clog the engine unless disposed of. He solves the problem by playing a current of superheated air upon the oil as it leaves the nozzle. This shatters the ingredients that can not be turned into gas and turns them into a combustible fluid, which is consumed during the explosion in the cylinder. When using crude oil, however, the motor must be started with gasoline.

Another time-saver in the operation of crude oil motors is a special igniter devised by C. A. Rudstrom. The ordinary method of starting a crude oil engine involves the heating of the hot-bulb with a blow torch, a process which takes several minutes. But Rudstrom requires only twenty seconds to start combustion in a cold engine. His igniter is brought to a glow by means of an electric current from a battery which is charged by a generator connected with the engine.

NEW EXPEDITION TO DARIEN

An expedition to further explore the area inhabited by the white Indians of Panama is about to penetrate into the interior of this country, hitherto practically unknown to all except the white and brown Indians.

Dr. and Mrs. Reginald G. Harris have joined Richard O. Marsh, who took three white Indian children and five brown Indians to the United States last summer, in this attempt to learn for science more details about the origin and cause of the unusual presence of many white-skinned Indians among the brown San Blas and mountain tribes. With Marsh also is Major Harry B. Johnson, naturalist, who accompanied him last year on his trip of exploration in this part of Darien.

Dr. Harris is director of the laboratory of the Long Island Biological Association at Cold Spring Harbor, N. Y., and he has already studied many of the white Indians along the coast with a view to solving the biological puzzle of their origin. Mrs. Harris is a daughter of Dr. C. B. Davenport, director of the department of genetics of the Carnegie Institution of Washington.

Marsh left the United States January 2 and brought back to their native land all but one of the Indians which he took north last summer. The smaller white Indian boy, a youngster of eleven, named Chepu, has been adopted by the Marsh family at Brockport, N. Y.

Reports reaching the coast indicate that there is much unrest among the mountain tribes who threaten an uprising against the negro rubber hunters who are penetrating the country and raiding the Indian plantations. All of the Indians are very friendly to the Marsh party, however. Among the brown San Blas Indians taken to the United States by Marsh was Iqua Negappi, "crown prince" of the San Blas, who will one day rule the whole coast.

PARATHYROID EXTRACTS AND TETANY

Successful treatment of parathyroid tetany, a deficiency disease caused by defects in the parathyroid gland, is announced as the result of researches by Dr. J. B. Collip, of the University of Alberta.

The parathyroid gland is an obscure body associated with the thyroid gland in the throat, in the region of the "Adam's apple." It is one of the ductless glands, whose secretions pass directly into the blood and are therefore very hard to isolate and study. Persons with parathyroid deficiency and animals from which these glands have been removed surgically, develop a condition known as "tetany," marked by extreme nervousness, spasms and stiffening of the muscles and other distressing symptoms.

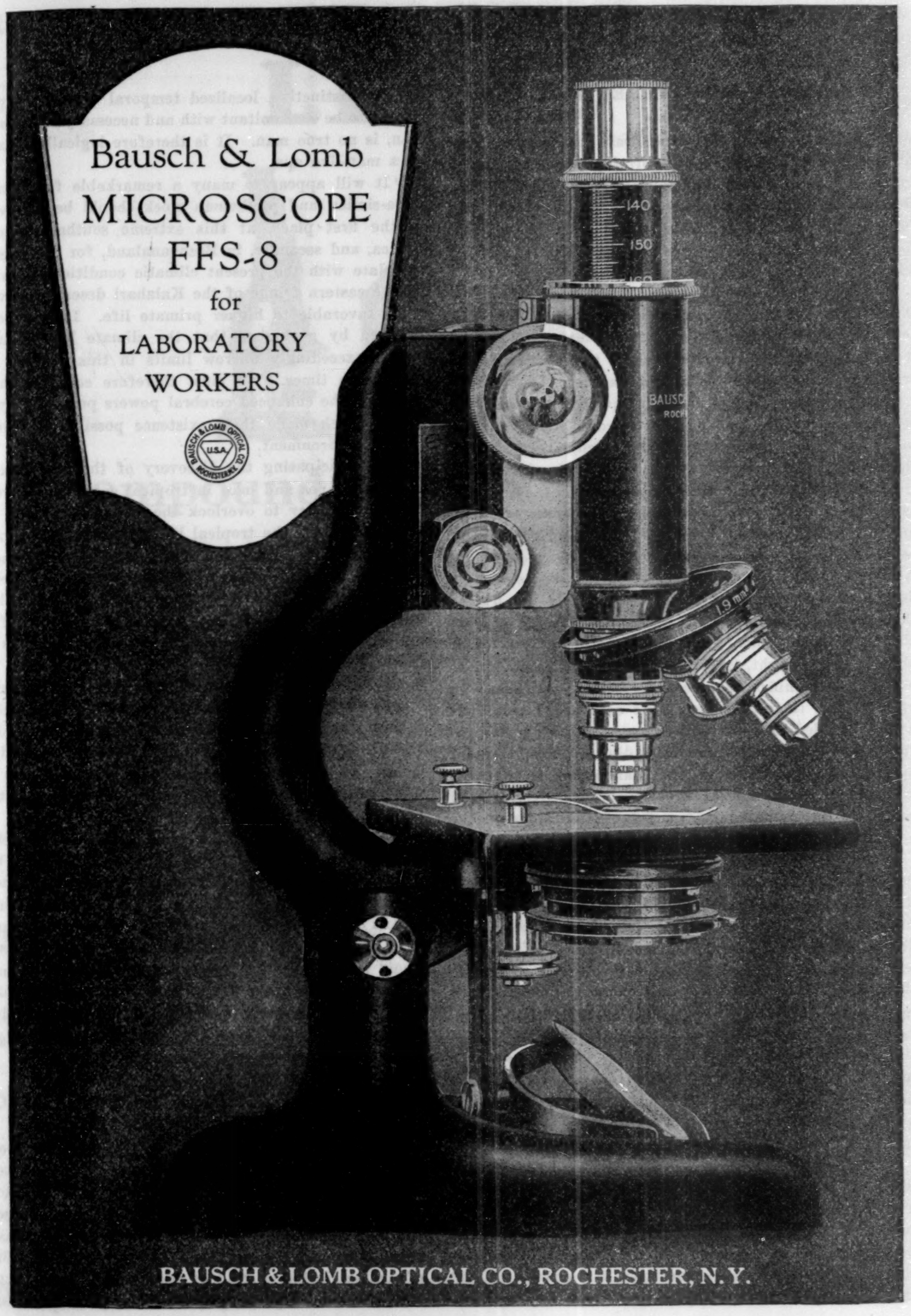
Hitherto there has been no effective treatment for this condition but Dr. Collip has succeeded in obtaining an extract from animal parathyroids, which he calls "parathyrin," and which seems to be the long-sought remedy. After a number of successful preliminary experiments with dogs, whose parathyroids had been operated upon, he tried the extract on a baby in a hospital, whose condition had become desperate. The child's life was saved and at last reports she was well on the road to recovery.

The operation of parathyrin in normal persons and animals seems to be connected with the quantity of lime in the blood. Tetany is accompanied with disturbances of the calcium concentration and when the extract is administered, normal conditions are restored.

ITEMS

Fireproof insulation for telephone switchboard wires is made possible by a new use recently discovered here of selenium, an element whose chief use hitherto has been in apparatus involving the control of electric current by light. The flameproofing of switchboard wires is highly important, for even a small fire can undo many hours of work and throw a whole exchange out of commission. Fireproofing substances now in use are only partially successful. The peculiar thing about the use of selenium for this purpose is that the element itself can be burned. Only when it is used on the cotton covering of the wires does it take on fireproof qualities. But then the wire resists all ordinary flames, and even when ignited by the intense heat of a blow-torch goes out immediately when the outside flame is removed.

A device which sends out distress signals from ships automatically has been invented by M. Passaquin, a young engineer. The instrument consists of wheels with projections around the edges corresponding to the signal, SOS, certain numbers which will give the latitude and longitude of the vessel, and the radio call of the ship. An ordinary electric motor operates the machine which is mounted on a table. Each wheel is set at the proper angle and the motor started. The signal flashes three times and then stops. After a short pause the signal is flashed again and again until the motor is forced to stop running. Ships or lifeboats equipped with this new invention do not have to have radio operators in order to send out messages of distress. A special dial on the transmitter may be set every day with the exact location of the ship and the motor turned on to operate the set whenever an emergency arises.



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SCIENCE NEWS

Science Service, Washington, D. C.

THE NEWLY DISCOVERED MAN-APE SKULL

From a study of the face and brain cast of the childish specimen of the man-ape, *Australopithecus africanus*, found at Taungs, Bechuanaland, Professor Raymond A. Dart, of Witwatersrand University, its discoverer, has come to the conclusion that this new creature, believed to be intermediary between ape and man, was far further advanced than any living anthropoid ape.

Professor Dart also declares that it seems probable that in view of this and other new and important discoveries connecting the early history of man with Africa, it is likely that the Darwinian claim that Africa is the cradle of mankind will be substantiated.

"This group of beings, having acquired the faculty of stereoscopic vision, had profited beyond living anthropoids by setting aside a relatively much larger area of the cerebral cortex to serve as a storehouse of information concerning their objective environment as its details were simultaneously revealed to the senses of vision and touch and also of hearing," Professor Dart says, referring to man-apes, of which the six-year old child, Australopithecus, is a sample. "They possessed to a degree unappreciated by living anthropoids the use of their hands and ears and the consequent faculty of associating with the color, form and general appearance of objects, their weight, texture, resilience and flexibility, as well as the significance of sounds emitted by them. In other words, their eyes saw, their ears heard and their hands handled objects with greater meaning and to fuller purpose than the corresponding organs in recent apes. They had laid down the foundations of that discriminative knowledge of the appearance, feeling and sound of things that was a necessary milestone in the acquisition of articulate speech.

"There is an ultra-simian quality of the brain depicted in this immature endocranial cast which harmonizes with the ultra-simian features revealed by the entire cranial topography and corroborates the various inferences drawn therefrom. The two thousand miles of territory which separate this creature from its nearest living anthropoid cousins is indirect testimony to its increased intelligence and mastery of its environment. It is manifest that we are in the presence here of a prehuman stock, neither chimpanzee nor gorilla, which possesses a series of differential characters not encountered hitherto in any anthropoid stock. This complex of characters exhibited is such that it can not be interpreted as belonging to a form ancestral to any living anthropoid.

"Unlike Pithecanthropus, it does not represent an apelike man, a caricature of precocious hominid failure but a creature well advanced beyond modern anthropoids in just those characters, facial and cerebral, which are to be anticipated in an extinct link between man and his simian ancestor. At the same time, it is equally evident that a creature with anthropoid brain capacity, and lacking the distinctive, localized temporal expansions which appear to be concomitant with and necessary to articulate man, is no true man. It is therefore logically regarded as a man-like ape.

"It will appear to many a remarkable fact that an ultra-simian and pre-human stock should be discovered, in the first place, at this extreme southern point in Africa, and secondly, in Bechuanaland, for one does not associate with the present climatic conditions obtaining on the eastern fringe of the Kalahari desert an environment favorable to higher primate life. It is generally believed by geologists that the climate has fluctuated within exceedingly narrow limits in this country since Cretaceous times. We must therefore conclude that it was only the enhanced cerebral powers possessed by this group which made their existence possible in this untoward environment.

"In anticipating the discovery of the true links between the apes and man in tropical countries, there has been a tendency to overlook the fact that, in the luxuriant forests of the tropical belts, nature was supplying with profligate and lavish hand an easy and sluggish solution, by adaptive specialization, of the problem of existence in creatures so well equipped mentally as living anthropoids are. For the production of man a different apprenticeship was needed to sharpen the wits and quicken the higher manifestations of intellect—a more open veldt country where competition was keener between swiftness and stealth and where adroitness of thinking and movement played a preponderating rôle in the preservation of the species. Darwin has said, 'no country in the world abounds in a greater degree with dangerous beasts than Southern Africa,' and, in my opinion, Southern Africa, by providing a vast open country with occasional wooded belts and a relative scarcity of water, together with a fierce and bitter mammalian competition, furnished a laboratory such as was essential to this penultimate phase of human evolution.

"In Southern Africa, where climatic conditions appear to have fluctuated little since Cretaceous times, and where ample dolomitic formations have provided innumerable refuges during life, and burial-places after death, for our troglodytic forefathers, we may confidently anticipate many complementary discoveries concerning this period in our evolution."

THE PREVENTION OF THE SPREAD OF PLANT AND ANIMAL DISEASES

The eternal vigilance that is the price of freedom from diseases of plants, animals and men was discussed before the Washington Academy of Science, on February 19, by representatives of the three government agencies charged with the task of keeping immigrant diseases from American shores. Dr. J. R. Moller, of the Bureau of Animal Industry, told of the development of quarantine and sanitary safeguards over the importation of

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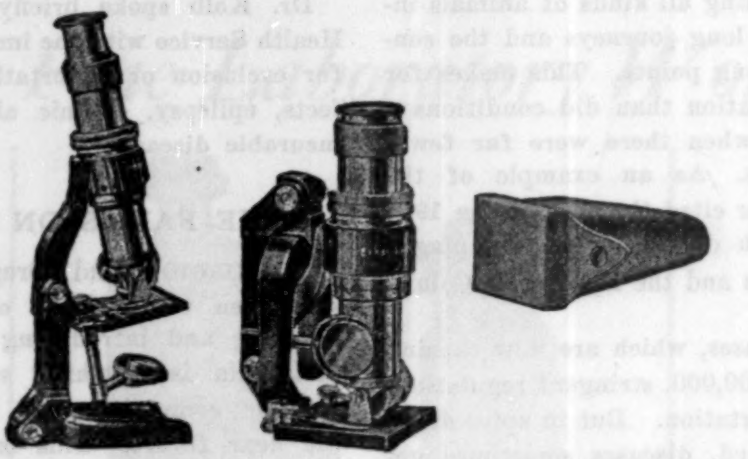

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animals; Dr. C. L. Marlatt, of the Bureau of Entomology, spoke on plant diseases and insect pests, and Dr. Lawrence Kolb, of the Public Health Service, summarized the situation as regards human immigration.

Two conditions, Dr. Moller said, are making it increasingly possible for an animal disease to make great headway once it gets a foothold. These are the great crowding to which dairy cattle are subjected and the present-day methods of handling all kinds of animals intended for market, with the long journeys and the congestion at market and shipping points. This makes for a much more dangerous situation than did conditions a couple of generations ago, when there were far fewer animals and no long hauls. As an example of the rapidity of spread, Dr. Moller cited the case of the 1914 outbreak of hoof and mouth disease, when the plague spread over twenty-two states and the District of Columbia in thirty days.

To combat live stock diseases, which are now causing an annual loss of over $200,000,000, stringent regulations are now imposed on all importation. But in spite of all precautions, Dr. Moller stated, diseases sometimes get through, and by most surprising means. The 1914 outbreak of hoof and mouth disease came in as a contamination in medical supplies from the Orient; the 1924 outbreak in Texas, which was not in any way connected with the California epidemic, apparently started from a pasture where aviators, smuggling contraband goods across the border from Mexico, were accustomed to land and where they threw away the hay used for packing.

A further danger pointed out by Dr. Moller lies in the fact that cattle which are denied entrance to gulf ports have been taken to Vera Cruz and sold there; and their diseases, of course, have an opportunity later to spread across the border.

Dr. Marlatt took up the tale for plant diseases and insect pests, and told of the struggle for the passage of an adequate plant quarantine act. Over fifty per cent. of our plant diseases and pests, he said, are aliens. Their dates of introduction range all the way from colonial days, when the Hessian fly and the codling moth came to America, up to the past three or four years. By a curious irony of events, he said, some of the worst pests were introduced by people with the best of intentions. The San Jose scale, for example, came in with a shipment of Chinese stock sent by a scientific missionary to a friend in California. The gipsy moth was introduced by a French professor of mathematics whose biological information was not on a par with the rest of his learning, and who had a notion that he could breed a race of hardy hybrid silkworms in Massachusetts. The white pine blister rust came in on imported seedlings, which had been raised in Germany from American seed.

The most recent and in some ways the most tragic of pest introductions was the coming of the Oriental fruit worm. This came in with a shipment of ornamental Japanese cherry trees, sent by the city of Tokyo to the city of Washington as a gesture of international goodwill. The worm has spread all over the Middle South, and it is feared that it will seriously affect the great peach region in Georgia.

As for the diseases not yet here, but awaiting their chance to get in, Dr. Marlatt said their name is legion. He has compiled a list of some three thousand of plant diseases and insect pests as yet unknown in the United States. And even more than the known diseases, he said, we must dread the unknown; for the latter can come upon us unaware and we do not know how to fight them until we discover them.

Dr. Kolb spoke briefly on the work of the Public Health Service with the immigrant. The principal causes for exclusion or deportation, he stated, are mental defects, epilepsy, chronic alcoholism and loathesome and incurable diseases.

GAME FARMS ON THE PACIFIC COAST

WASHINGTON and Oregon have become Edens for sportsmen through the operation of large farms for breeding and introducing game birds for many lands. California is watching with the interested eye of a possible competitor and contemplating like action in the near future. This is the gist of a report to the California Board of Fish and Game Commissioners by Executive Officer George Neale, who has just returned from a tour of inspection of the game farms of the northern coast states.

Oregon has three state game farms, maintained out of hunters' license fees, from which nearly 22,000 pheasants were set free during the two-year period 1923–24 and where breeding stocks of several thousands of Chinese and Mongolian pheasants and Hungarian partridges are constantly maintained. Washington has two game farms, which propagate not only the pheasants but also grouse, two species of partridges and the eastern bob-white. One unique feature of the Washington farms is the fact that one of them is maintained by the labor of convict "trusties," and the other by the more competent inmates of the state institutions for the mentally afflicted. Good results are claimed in both places.

"A peculiar situation now exists in both of these states," concludes Mr. Neale, "inasmuch as some native game birds are strongly recommended to be placed on the protected list for a number of years, while nearly all the introduced game birds, domestically raised and liberated, are now on the open list and furnish the sportsmen ninety per cent. of the upland bird shooting."

THE DEVELOPMENT OF PHOTOGRAPHIC FILMS AFTER FIXING

TOPSY-TURVY methods of developing photographic films and plates, by which the process is carried out in daylight instead of a dark-room, and the film is placed in the fixing bath first and then in the developer, has been shown possible as the result of experiments made at the Wagner Free Institute of Science, by Dr. Henry Leffman, over a number of years. The plate or film is first placed in a dilute solution of sodium thiosulfate, commonly called "hypo." This is done in a dark-room. Although it seems entirely transparent when brought out into daylight, it is placed in a special developer and the image

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appears. The inventor of the process claims that this is a great advantage since there is plenty of light to observe the action.

In photography, the silver bromid is mixed with some substance such as gelatine that can be spread out in a thin layer on a glass or celluloid support. This forms the plate or film and when exposed in the camera to the image formed on it by the camera lens, the parts struck by the light are affected, while the others are not. No change is apparent if the film is then examined, but this invisible or latent image may be brought out by development, which changes the latent image into one of very minute particles of metallic silver. This process leaves the parts that were not reached by the light as unchanged silver bromid, so it is necessary to remove it by fixing. Sodium thiosulfate dissolves the silver bromid, but not the metallic silver and the result is the familiar "negative," with dark areas corresponding to the lights of the original scene.

This being the case, it would seem that if the silver bromid were first dissolved away by fixing, the latent image, supposed to be due to a change in the molecule, would go with it but Dr. Leffman has demonstrated that it persists in the gelatin itself. The ordinary developer can not be used but by means of a special one containing mercuric chlorid or bromid, metallic mercury is deposited where the silver would have been if the plate had been treated in the usual manner and the negative may be printed in the ordinary way.

THE ACQUISITION OF MALE CHARACTERS BY FEMALE PIGEONS

The changing of sex from female to male in a number of pigeons in flocks kept for scientific study at Cold Spring Harbor, Long Island, has led Dr. Oscar Riddle, of the department of genetics of the Carnegie Institution of Washington, to some interesting and far-reaching speculations.

Dr. Riddle's observations started several years ago, when a female pigeon, as a result of a diseased condition, turned into a male. After a life of normal housewifely behavior, she ceased laying eggs, and after a time began conducting herself—or rather "himself"—as a male in mating behavior. When the pigeon died, it was found that the female sex gland—all female birds have but one ovary, the left—had degenerated, and that on the right side of its body a male sex gland had developed.

This led Dr. Riddle to further investigations. In many dissections which he conducted himself and in numerous recorded cases which he examined, he discovered that wherever similar changes of sex in birds or mammals had occurred, it was always on the right side that male reproductive tissue developed, either exclusively or at least to a larger extent than it did on the left. He also found that in normal male individuals there was a tendency for the left sex gland to be smaller than the right.

The whole situation leads to the interesting suggestion, in Dr. Riddle's opinion, that there is a difference in degree of sexuality between the two halves of the body, the right side being more strongly male in male animals, and the left side more strongly female in female animals.

Another suggestion is put forth by Dr. Riddle. The determination of what sex an animal is going to be has always been supposed to be unchangeably fixed from the very beginning of life development. There are certain structures in the cell, called chromosomes, that in most cases seem to settle the matter once and for all. These changes in sex, taking place long after birth, appear to bring the whole idea of the unchangeable determination of sex into question. Dr. Riddle suggests that not only the character of sex, but "other chromosome-determined characters may have the course of their development altered; and thus heredity may not have the fatefulness usually ascribed to it. It does not follow, however, that the hereditary factors are transformed, nor that the character-transformation at all affects the succeeding generations."

ITEMS

In the January 2nd number of **Science** it was stated that the first large artificial single crystals of copper were made by Professor P. W. Bridgman. These crystals were made by W. P. Davey, of the Research Laboratory, General Electric Company, Schenectady, N. Y., using a slight modification of the unpublished method developed by Professor P. W. Bridgman for metals of much lower melting point.

The production of sponge iron, a finely separated form of the metal and very useful in chemical and metallurgical industry, has been made possible on a large scale by researches conducted at Seattle by the Bureau of Mines of the U. S. Department of the Interior. The process depends on the fact that most iron ores are oxides of iron, and that if the oxygen can be extracted at temperatures so low that the iron does not fuse or run, it is left standing as a very fine, porous metallic sponge, presenting very large areas of free surface, on which the reactions of chemical manufacturing processes can take place. The process also promises to render possible the profitable production of iron from low-grade ores and furnace wastes.

The eclipse of the sun had no direct effect on the heights of tides, according to officials of the U. S. Coast and Geodetic Survey. Variations in the height of tides are greatest and least at new and full moon, when the sun and moon are practically in the same line with the earth. At the time of the eclipse, the earth, moon and sun were lined up and the combined pull of the two heavenly bodies was being exerted on the earth and its waters; but this pull was not appreciably greater than at the usual periods of full moon. In checking up one of the several reports of unusual tidal conditions attributed to the eclipse, experts of the U. S. Coast Survey discovered that the supposed effect occurred four hours after the eclipse and was no greater than that recorded for the day before the eclipse.

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SCIENCE NEWS

Science Service, Washington, D. C.

MIRA, THE SECOND LARGEST STAR

A GLOBE of glowing gases 250,000,000 miles in diameter, so vast that if the sun were placed at its center there would be sufficient room for the earth to revolve in its customary orbit; such is the nature of the star Omicron Ceti, known to the ancients as Mira, "the wonderful," because of its remarkable and periodical variations in brilliance.

The observations from which these measurements were calculated were made by Francis G. Pease, astronomer at the Mt. Wilson Observatory, Pasadena, California, using the great 100-inch reflecting telescope, the largest in the world. The method employed was one invented by Professor A. A. Michelson, of the University of Chicago, by means of which a device called an interferometer is attached to the top of the telescope.

With a system of mirrors, the light from the star is divided into two beams, which, when reunited, give rise to a series of light and dark bands. This is because the waves of light in the two beams get out of step and thus, at certain positions, interfere with each other. It is analogous to what might occur with waves in a pool of water. If there are two sets of waves, the peaks in one coinciding with the troughs in the other, they will tend to cancel each other. This effect is called "interference."

When the mirrors of the interferometer are moved, a place is found where the interference bands vanish and from the distance apart of the mirrors at this point, the apparent diameter of the star may be calculated. This is the angle between two lines coming from opposite edges of the star and meeting at the earth. In the case of Mira, the apparent diameter is about six hundredths of a second of arc, the same as that of the head of an ordinary pin five miles away!

Obviously this apparent diameter has no direct relation to the actual size, for a small object nearby may appear larger than a much greater one at a distance. By other means, however, the distance of the stars may be determined and when known, the actual diameter may be calculated. Thus Mira is about 165 light years away. A light year is the distance that light can travel in one year, about 6,000,000,000,000 miles, since it can encircle the earth seven times in a second! The distance of Mira from the earth is therefore too many billions of miles to think about.

Since 1920, when Michelson's method was first applied to the measurement of stellar diameters, Mr. Pease has measured five other stars. The first one was Betelgeuse, a bright star in the constellation of Orion, which now adorns our southwestern sky in the evening. Alpha Orionis, the astronomers call it and it may be seen above the three stars in a row that form Orion's belt. Its diameter is 215,000,000 miles.

After this he measured Arcturus, in the constellation of Bootes, which he found to have a diameter of 20,000,000 miles, Aldebaran, the red star in Taurus, the Bull, which is 30,000,000 miles across; Scheat, the second brightest star in Pegasus, which is 150,000,000 miles; and, largest of all, Antares, "the rival of Mars," in the Scorpion with 400,000,000 miles!

Mira, therefore, is the second largest star known but it is important because it is a variable star. Periodically it varies from the second magnitude, when it is prominent in the southern sky in early winter evenings, to the eighth magnitude, when it is too faint to be seen by the unaided eye. Another feature of great interest is that it is a double star. It is not a single body, but consists of two stars close together, and which revolve around each other. The companion was discovered about a year ago by Dr. Robert G. Aitken, associate director of the Lick Observatory, with the 36-inch refracting telescope there, after Dr. Alfred H. Joy, at Mt. Wilson, had predicted its presence by studying observations of the star made with a spectroscope.

CRIMEAN NEANDERTHAL REMAINS

PROFESSOR BONTISCH-OSMOLOVSKY in an interview with a Science Service representative has stated the details of his recent find of two primitive human Neanderthaloid skulls near Simferopol, in the Crimea, hundreds of miles to the eastward of any previous discoveries of that race of cavemen.

"I had an idea that when the last glacial period began, something less than fifty thousand years ago, the men then living retreated before the oncoming cold into the country now known as the Crimea," said Professor Bontisch-Osmolovsky. "In 1923 I began systematic explorations to test this theory, twenty-five miles from Simferopol, near the village of Kipchak. In a cave known as Koush Kbat I came upon my first evidences. I found here skeletal remains of the mammoth, Siberian rhinoceros, cave hyena, cave bear, wild horse, wild ass, deer and other animals, together with a number of small primitive tools and the remains of a hearth, which indicated that the cave had once been a dwelling place of human beings.

"In 1924 I made my first find of actual human remains in a neighboring cave called Kiik Koba, in geological strata of the quaternary period. Here were two fragmentary hearths, with layers of ashes and coals and here, in regularly made graves, were two human skeletons. In this cave also were remains of the same animals I had found in my first explorations, together with many flint implements, typical of the Middle Paleolithic period. This is the first find of its kind ever made in Russia, and is in my opinion a discovery of great scientific importance.

"The bones are very different from those of modern man. Their measurements have not yet been completed, but those so far made suggest that they are representative specimens of the Neanderthaloid race. Some pieces,

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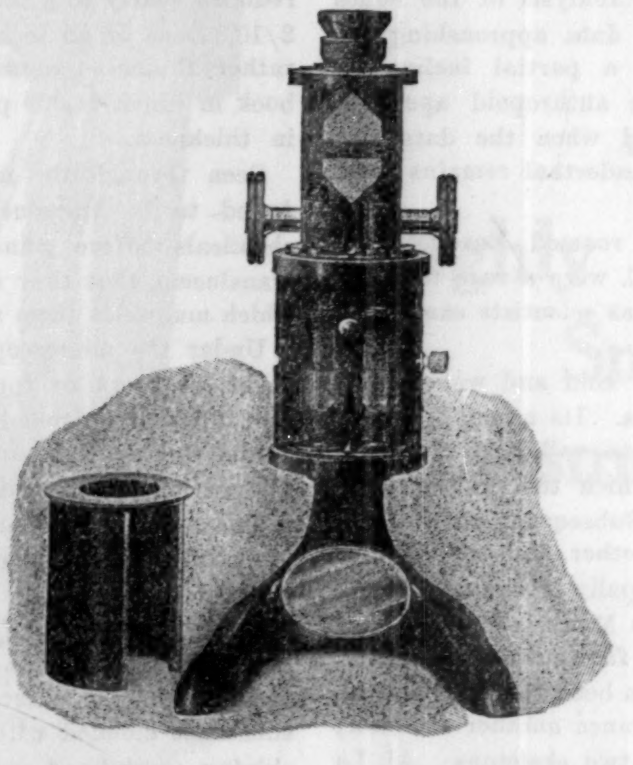

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including a part of one of the skulls, are still missing, and I hope to find these by further search. Investigation of all the material in the Kiik Koba cave can not be completed in Russia, since there is no comparative material in this country for a study of Middle Paleolithic Quaternary man."

Professor Joukoff of the Anthropological Research Institution states that statistical analysis of the bones of the Kiik Koba skeleton gives data approaching the Neanderthaloid type, with even a partial inclination toward the conformation of the anthropoid apes. A final decision will be pronounced when the data can be compared with figures for Neanderthal remains from older finds in western Europe.

The primitive cave men that roamed Europe from about 50,000 B. C. to 25,000 B. C. were a race that has left no direct descendants, so far as scientists can judge to-day.

This early race lived in a very cold and wet climate in the midst of the great Ice Ages. Its name, Neanderthal, is derived from the limestone valley of the little Neander river in Germany, in which the first skeleton was found by anthropologists. Subsequent to the first or type discovery about twenty other finds of remains of this race have been made principally in France, though they extended eastward as far as Moravia in what was formerly Austria-Hungary and as far south as Gibraltar. One skeleton, that of a woman, has been found at Gibraltar; at Chapelle-aux-Saints, in France another skeleton; in the cave of Spy, in Belgium, two skeletons. At La Ferrasie the remains of seven or eight persons were found and at La Quina a wholesale burial of fifteen. Other smaller finds have been made, sometimes consisting of but a fragment of a skeleton.

Together the finds constitute a rich fund of material from which much information has been deduced. They were a squat, blocky people, probably walking with a shuffling, shambling gait, instead of freely and erect, like the tall Cro-Magnons, who later replaced them. They had heavy jaws and powerful teeth, indicating a diet of tough food, much of it possibly raw. They were decided "low brows," with backward-sloping foreheads.

Yet they were not brutes. They had large brains and knew how to make stone tools. We even can be fairly sure that they were right-handed, for one side of the brain was larger than the other. They had little or no art but they had at least the beginnings of religion, for they buried their dead.

It is unlikely that they are part of modern man's family tree, for they had many features that are not represented in the present human types. There is just a possibility, lately emphasized by a French anthropologist, that some of the more primitive of modern savages may have a strain of Neanderthaloid blood in them. But to most of the present-day human race, they were great-uncles rather than grandfathers.

COAL, JEWEL AND FUEL

Coal is like character, the deeper you go into it the more interesting it becomes and there is much in it that, unsuspected, is beautiful. Ordinary bituminous coal is dirty, black and uncouth and anthracite is none too clean; but if you cut from a lump of coal a slice thin enough to be translucent and examine it under a microscope you will see what beautiful things coal is made of.

The preparation of such a thin section is a most delicate task. First a thin flat piece from a lump is sawed out and then ground down smoothly until it is reduced nearly to a film—that is, until it averages about 2/10,000ths of an inch in thickness. This thickness—or rather thinness—would correspond to the leaves of a book in which 14,000 pages make a volume only one inch in thickness.

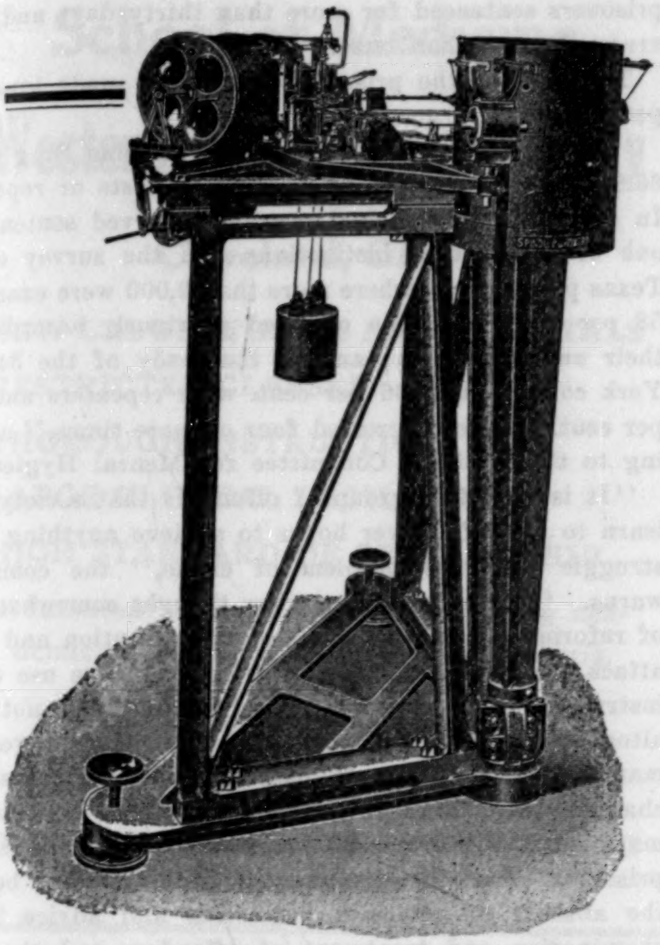
Seen through the microscope such slices of coal are found to be translucent and if treated with certain chemicals before grinding, they will be so beautifully translucent that they may be examined by a microscope which magnifies them more than 1,800 times.

Under the microscope the coal is no longer dark as night, or sooty or forbidding. In the cross section of that dirty lump one beholds a landscape in brown and gold. Golden links in serried chains bound in filigree fill portions of the view.

The links are the cross sections of the cells of pieces of wood of twig, branch or log that enter into the product we call coal. Each cell in the wood is a jewel box of gold. In the hollow interior where once were protoplasm, starch and other substances embracing the very life of the plant, we find a transparent amberlike substance clouded with sepia and containing clusters of shining crystals of utmost minuteness, together perhaps, with tiny glistening globules of gas. Stem of leaf and fern and scale of catkin or cone, are seen in tissues traced in saffron and orange, straw-color and russet. Scattered here and there are a thousand spores of club moss, fern or fungus and pollen of many kinds of flowers, now appearing as ovals, clasps and crescents of luminescent brass or antique gold. Festooning skeins in brown, knit with silver representing cross sections of fragments of inner tissue of leaf or bud are perhaps present; and resins of different kinds, brownish, amber, yellow or red, stud the pattern like precious stones. Real amber used in jewelry is, you know, a fossil resin. Yonder mesh of old gold sealed over with a mosaic in glistening topaz-yellow is a piece of the outer wall of a leaf. The fragile labyrinths traced in pale yellow and silver are the cross sections of fragments of "mineral charcoal," the so-called "mother of coal." The scene changes from area to area and from specimen to specimen.

All these details of tracery and mosaic are set in a background—the groundmass—of cinnamon verging into sepia and brownish black, which fills the spaces. This composes the dark shadows of the picture.

Geological as well as the microscopical study of coals proves that all the ordinary kinds of coal, including anthracite, began their existence as peats deposited in vast swamps that once spread back of the low coasts or in the interior lowland basins of the continents in ancient geological times. The wood fragments, twigs, leaves, seed coats, spore cases, now chemically transformed in colors of gold and brown, are the plant



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débris that was saved from decay by the germ-poisonous products developed by bacteria at or near the surface of the peat on which this débris was deposited. However, the great chemical and physical transformations by which the peats were changed to lignite, subbituminous, bituminous, semibituminous coals and anthracites have been brought about by geological processes instead of by bacterial action. The principal agents in this geological transformation are pressure, heat and time.

The pressures taking part in the conversion of peats to coals of different ranks are, first, the downward pressure of weight of hundreds—perhaps many thousands—of feet of beds of sand, mud, limestone, etc., piled on top of the peat bed as the region was sinking or the basin was filling. Second, and far more effective, however, are the horizontal pressures which build mountains by causing great wrinkles in the earth's crust.

Most earthquake zones are the scenes of compression and mountain building, though the movement is invisibly slow. The coals have progressed farthest on the road to anthracite and graphite in those regions where the greatest actual horizontal compression of the peat containing strata has taken place.

The temperatures developed in the process are those due to depth of burial of the deposit. This amounts to about a degree Fahrenheit to each 80 feet downward through depths averaging about 2,000 feet. Added to this is the heat generated by friction due to the compression through millions of years of the rocks as just described and also the heat caused by chemical action in the buried strata. Altogether, the temperatures in the coal beds were probably less than 300 degrees Fahrenheit in most coal regions. Lowness of temperature is, however, compensated by great length of geologic time, time and temperature being, in fact, partially interchangeable in the geological transformation of coals.

Coal is still the world's greatest source of industrial power and it will remain so for a long time, for the coal reserves of the world probably exceed 10,000 billion tons. Our portion, over 3,500 billion tons, of these vast supplies, should last us many centuries in spite of increasing population and expanding industries, though our coal exportation probably will not grow correspondingly. The actually depressing feature is that we are rapidly mining our limited reserves of best and most valuable coals first. It will be no long period before our so-called smokeless or Navy coals will be largely consumed and we shall be using inferior and generally dirtier coals mined from thinner beds, at greater depth and at greater cost.—*Dr. David White.*

THE MENTALITY OF CRIMINAL DELINQUENTS

MORE than half of 10,000 criminal delinquents examined by the National Committee for Mental Hygiene have been found to be mentally diseased, feeble minded or otherwise mentally abnormal. This number included inmates of prisons, reform schools and those on probation to the courts.

As a result of this examination Sing Sing will establish a psychiatric clinic to study each prisoner upon entering. The subnormal will be segregated from the normal and kept under state control. Massachusetts has passed a bill requiring the psychiatric examination of all prisoners sentenced for more than thirty days and those arrested more than once.

The bulk of the prison population is made up of repeaters.

"In the study of 608 admissions to Sing Sing prison 66.8 per cent. were found to be recidivists or repeaters. In other words, they had previously served sentences in one or more penal institutions. In the survey of the Texas penitentiary where more than 3,000 were examined, 58 per cent. had been arrested previously according to their own admission; and in the study of the 34 New York county jails, 66 per cent. were repeaters and 27.9 per cent. had been arrested four or more times," according to the National Committee for Mental Hygiene.

"It is with this group of offenders that society must learn to deal if it ever hopes to achieve anything in its struggle with the problem of crime," the committee warns. "It has in recent years thought somewhat more of reformation and a little less of retribution and in its attack upon the problem has made extensive use of the instrument of probation. The results have not been altogether satisfactory and there has ensued a reaction manifesting itself most markedly in criticisms that charge sentimentality and denounce the leniency of many of the courts and juries in their dealings with prisoners. But the weakness of probation has been in the absence of competent direction and advice in the examination and treatment of offenders and the oversight of the vitally important mental and emotional factors that can not be ignored in any attempt to understand the behavior of these offenders and prescribe adequate rehabilitative measures."

ITEMS

BUILDINGS may be rendered secure against the ravages of the wood-eating termite, or white ant, by a method described by Professor S. F. Light, of the University of Amoy. Professor Light's method depends on the fact that some termites require constant access to the earth to carry on their operations, either through galleries which they bore through the wood or through covered ways which they construct over the faces of brick or stone foundations. He simply cuts off all chances for this communication by inserting a sheet of galvanized iron, or "termite shield" as he calls it, into the masonry and turning the projecting edges downward at an angle. A variation of the method, which he states has been used in Africa, consists in placing metal caps over the tops of construction pilings.

SCENTED decoys for the deadly tsetse fly are now employed in up-country districts by government entomologists. In order to trap and destroy the insects which cause sleeping sickness, dummy animals are being erected upon which the flies light with the intention of biting the animals. If animal odors cling around the dummies the flies will linger about until killed. Images of donkeys with brown paper legs are commonly employed.

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Owing to an extensive building program about to be inaugurated at the Hospital and Medical School, it has been deemed necessary to withdraw, for the next two years at least, post-graduate instruction during the year as well as the summer course formerly given during June and July.

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NEW LINES IN ECLIPSE SPECTRUM

MANY bright lines, never before observed and each indicating the presence of some chemical element, have been found in photographs made of the red and infrared light from the sun at the time of the total eclipse of January 24 by Professor H. D. Curtis, director of the Allegheny Observatory of the University of Pittsburgh, it was announced recently. These photographs were made at New Haven, Connecticut, where Dr. Curtis accompanied the eclipse expedition from Swarthmore College. They were made both of the flash, the outer layer of the sun which can only be seen just before or just after totality, when the remainder of the sun's surface is covered by the moon, and of the corona, which is only visible when the sun is completely covered.

The apparatus used is a grating spectrograph in which a curved piece of metal on which are ruled many fine parallel lines, 3,600 to the inch, takes the place of the usual glass prism in spreading the beam of white light out into a colored spectrum. Dr. Curtis states that this apparatus is especially adapted to recording the spectrum in the deep red region, and the part beyond, called the infra-red.

The deepest red waves visible to the eye are about one thirty-three hundred thousandth of an inch long, and the longest previously recorded in the flash spectrum are about one four millionth of an inch in length. Dr. Curtis's plates show many lines, up to those corresponding to a wave length of about one twenty-eight hundred thousandth of an inch. Among these are many lines never before observed. Some of them have been identified as being due to elements known on the earth, while several can not be found to correspond with any known element. One of them, found in the coronal spectrum, Dr. Curtis stated, may possibly be due to the element coronium, known only in the sun's corona. It is believed that similar photographs, made at another eclipse, will throw much light on their origin.

METABOLISM OF CRYING BABIES

WHEN a baby cries it means hard labor for himself as well as for his afflicted parent. Drs. J. R. Murlin, R. E. Conklin and M. R. Marsh, of the University of Rochester, have been conducting careful measurements of the energy used up by crying babies, and they find that the metabolism, or rate of food-use, by crying babies is markedly higher than that of infants contentedly cooing or sleeping in their cribs. Crying one per cent. of the time increases the use of energy one per cent.; so that if a baby cried all the time it would double its energy requirements and hence the amount of food it would need.

Assuming that a child could keep up such a distressing performance for a day and a night and assuming further that one fifth of the energy could be transferred into muscular work, the doctors calculated that on this basis this imaginary long-time squaller could develop enough power to lift himself to the top of the Washington monument.

Just how far the harassed father would walk in that time or how much energy he would use up in the process, the doctors do not state. They do, however, draw the practical conclusion that crying is a very wasteful process as well as an annoying one and that economy as well as comfort requires that babies be so cared for that they have little occasion to cry.

WATER POWER DEVELOPMENT

BECAUSE of Canadian governmental policy against exporting power it is probable that the St. Lawrence River project and the Carillon project, an undertaking larger than Muscle Shoals and requiring the exporting of power from the Ottawa River, will be blocked indefinitely, according to information reaching the United States Department of Commerce.

With the completion of these plans, power would have been furnished the manufacturing districts in New England at a figure below the present cost. Only one third of the expense of the St. Lawrence plan could be borne by the United States, however, as not more than sixty miles of the mileage of the proposed development are a part of the international boundary line.

The St. Lawrence project is a combined waterway and power development plan worked out by a group of American and Canadian financiers. For power development a super power plant would be built at the base of Lake Ontario. This super power plant would have to produce 300,000 kilowatts per hour or one half of the power produced on both sides of Niagara Falls. The waterway plan would, by deepening the channel of the St. Lawrence, link the Great Lakes with the sea.

Closely allied to and almost a part of the St. Lawrence scheme is the Carillon project. A huge power plant would be built at the small town of Carillon on the Ottawa River. Power from this plant could supply not only prospective Canadian needs but most of the eastern United States as well. The Ottawa River flows between the provinces of Quebec and Ontario and the premiers of these two provinces are bitterly opposed to the plan. Since the money for the initial payments on the work has been raised and since the project is so large it is probable that the Dominion government will make the final decision.

An important step in super power that seems likely to materialize is the ratification of a power treaty contracted by New Jersey, New York and Delaware. These states have agreed among themselves to share the power of the Delaware River, and it remains for the legislatures to ratify the agreement. Metropolitan New York will benefit most from the plan as extra power will come in from the Delaware watershed.

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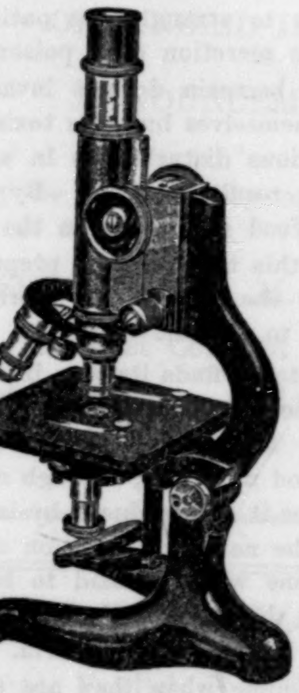

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houses and coal,'' said Paul S. Clapp, secretary to the Northeastern Super Power Committee. ''By concentrating these power houses at a number of centers much of this expense will be eliminated, as coal can be bought in large quantities and stored, larger and more efficient machinery can be used and arrangements can be made for transferring the amount of energy needed for peak loads from one plant to another.''

The Northeastern Super Power Committee, organized by Herbert Hoover, secretary of commerce, in the interest of eliminating waste, consists of representatives from New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania and Maryland. Investigations were made as to the feasibility of a power system connecting these states in an interlocking system. The northeastern part of the United States was chosen as a field for investigation because sixty per cent. of the manufacturing is carried on in them and they have forty per cent. of the population.

''The United States naturally divides itself up into power areas,'' Mr. Clapp continued, ''and will have to be developed as such. We chose the northeastern part of the United States to make our survey because of its industrial importance. We found that about thirty-eight per cent. of the water supply had already been developed and that not more than twenty-five per cent. of the total supply could come from water alone.

''Water is not a constant thing; varying with the weather, it is sometimes impossible to carry out the power contracts undertaken by the companies. Undoubtedly most of the future power development rests with steam.

''Power at the mines, however, is not the answer to the question as it is usually impossible to get water in sufficient amounts to condense the steam. Experiments with super power in Germany have attempted the use of the power at the mines plan but it was found that pumping the water and forcing it down water towers is an overwhelmingly expensive process.

''Super power or giant power means interconnection and consolidation of stations and is necessary in all areas of the country.''

DIPHTHERIA

In spite of the terror in which it is held, diphtheria is probably the most studied and best understood by the medical profession of all the diseases that afflict mankind. The causal organism has been known for a long time, its action also is known and the toxin or poison it secretes has been studied. Physicians have learned how to prepare an antitoxin that neutralizes the toxin when the disease has already gained headway, they have devised a method for determining which individuals are naturally immune and which are liable to the disease and lately they have worked out a way of rendering non-immune children safe against it for years and perhaps for life.

The germ of diphtheria was discovered in 1883 by Klebs and Loeffler, two German scientists. It is a short rod-shaped bacillus, slightly curved and frequently club-shaped. It is visible only under the most powerful microscopes for it is only about a thousandth of an inch long. It is present in immense numbers in the throats of diphtheria patients but it is also found very frequently in the mouths and throats of perfectly healthy persons. Such persons may be naturally immune, so that they will never get the disease and simply act as ''carriers'' for the germs; such immune carriers are frequently a great danger to a community. Or, a susceptible person may carry the germs about with him for a long time; then suddenly develop diphtheria when for some reason his resistance falls.

The symptom people most readily associate with diphtheria is the formation of a ''false membrane'' in the throat which threatens to strangle the patient. More serious, however, is the secretion of a poison, or toxin, by the bacteria. The bacteria do not invade the patient's blood stream themselves but this toxin is poured into it and causes serious disturbances in all parts of the system which may result in death. By cultivating the germs on special food substances in the laboratory an extract containing this toxin can be prepared, which is of use in studying the disease but more especially in preparing antitoxin to cure it.

Normally, when the toxin finds its way into the blood, the body tissues secrete a substance that neutralizes it. This is the antitoxin. Antitoxin is formed whether the toxin gets into the blood naturally, through an infection in the throat or whether it is introduced by injecting the laboratory extract. The natural formation of antitoxin is what protects persons who are said to be naturally immune and it is also the cause of spontaneous or natural recovery from an attack of diphtheria. Most children are naturally immune when they are born; probably antitoxin from their mother's blood passed into their bodies before birth. This ''natural born'' immunity passes off before the child is one year old and leaves most children highly susceptible. The highest diphtheria rate occurs among children between three and four years old. During childhood and especially during adolescence most people build up natural resistance, apparently by receiving and throwing off slight infections and thereby storing up reserves of antitoxin in the blood or at least by ''forming the habit'' of making their antitoxin quickly when an infection occurs. Very few adults die of diphtheria.

Antitoxin generated in one person or animal may be transferred to another. This is taken advantage of by the preparation of the serum now widely used, the discovery of which is credited to Behring and Roux—a German and a Frenchman. Doses of diphtheria toxin are injected into sound and healthy horses and after they have had time to develop antitoxin a certain amount of blood is drawn off. The animals are well treated and often yield antitoxin material for many years. The blood is cleared of all but the watery serum, which is sterilized and tested on guinea pigs, and then sealed up in glass tubes ready for medical use. During the first five years of the use of antitoxin the death rate from diphtheria

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fell off fifty per cent. and during the next ten or twelve years the remaining rate was again halved.

The Schick test, which shows whether a person is susceptible to diphtheria, consists simply of injecting a very tiny quantity of the toxin into (not under) the skin. If the child is immune nothing happens; if susceptible, a redness and subsequent "peeling" of the skin indicates a "positive" reaction. Sometimes there is a false, or "pseudo" reaction; but physicians can easily detect this. This test was devised in 1913.

Still more recent is the use of a mixture of toxin and antitoxin, carefully balanced as to strength, and injected into the arm. This treatment was worked out by Dr. Wm. H. Park, of New York, only about five years ago and is the most recent step in the conquest of diphtheria. For some reason, an injection of antitoxin does not give permanent immunity; after a few weeks the effect wears off. But the use of the toxin-antitoxin treatment seems to give permanent protection; certainly the immunity thus acquired has not worn off in several years in the cases where it was first used. Persons who were given the toxin-antitoxin treatment and subsequently Schick-tested proved to be immune in 97 per cent. of all cases.

The Schick test and the toxin-antitoxin treatment where needed, are now used on all school children in many communities. However, that only partly meets the situation, for the greatest danger from diphtheria comes before school age—around three years. When the public in general shall have been educated to an understanding of the value of testing and immunization for very young children, diphtheria will become as extinct as the dodo.

COCAINE ADDICTS

HUMAN beings can not continue taking cocaine indefinitely nor can a tolerance to this dangerous drug be built up as is commonly supposed, Professor A. L. Tatum, of the University of Chicago, has found as a result of experiments and observations in the university laboratory of physiological chemistry and pharmacology.

Taking cocaine away from a habitual user has no more disastrous effect than taking tobacco away from a confirmed smoker, Dr. Tatum maintains, since the body does not require the continuance of the drug once it has been withdrawn. The contrary is true of morphine, the drug to which cocaine addicts often turn.

Experiments recently completed on laboratory animals show that cocaine addicts, after a considerable period of time, suffer from a poisoning which produces tissue degeneration, causing painful physiological reactions that force them to abandon the habit.

"Cocaine administered to laboratory animals develops an increased sensitivity toward the drug," Professor Tatum explains. "This is in confirmation of results obtained by other investigators. Cocaine poisoning over a considerable length of time produces tissue degeneration. Similar degenerative change produced by other means, such as phosphorus or chloroform poisoning, increases the sensitivity toward cocaine.

"Consequently it is our view that the increased sensitivity in laboratory animals has its basis in cell injury."

Addicts "cured" of the cocaine habit can go back at once to the dosage used at the height of their so-called addiction with no excessive or exaggerated effects, contrary to morphine addiction in which case after a cure the subject must begin again with a small dosage with gradually increasing dosage as he redevelops a tolerance.

Cocaine addiction is usually of relatively short duration, estimated from one to three years, when the subjects voluntarily stop the use of cocaine because of the undesirable effects.

The absence of a developed human tolerance, lack of abstinence symptoms on withdrawal and the short course of the addiction, all point to a similarity of bodily effects on man and laboratory animals; man and laboratory animals differ essentially in their psychic reactions which is the basis of the human addiction. The lower animal counterpart of the human cocaine psychosis has so far never been discovered.

ITEMS

AN accurate measurement of the refraction of X-rays has recently been made by Professor Bergen Davis and his co-workers at Columbia University. The bending of the rays at the surface of matter is very small but by proper refinements of apparatus it can be measured quite accurately. These measurements permit the computation of the number of electrons in the inner level of an atom. The number found is two, in agreement with the Bohr scheme of atomic structure. The possible refraction of X-rays was indicated by the experiments of Stenstrom a few years ago. Recently Professor Manne Siegbahn, of Upsala, Sweden, succeeded in showing this refraction directly by the bending of the rays in passing through a glass prism.

THE French Minister of Colonies has set aside, by executive decree, a number of islands owned by France in the Antarctic regions as game sanctuaries for polar bear, walrus, sea lions and other animals. The protected area includes the islands of Crozet, St. Paul and Amsterdam, Adelia Land and the Antarctic coast between Doigt de Sainte Anne and Port aux Lapins.

AN Albert National Park in the Belgian Congo will be created in the near future by royal decree. The region selected is a high table-land between Lake Kuon and Uganda. Protection will be given to both animals and plants, and hunters will be forbidden to penetrate into the region.

THE presence of some of the rarer elements in petroleum ash has been demonstrated in experiments now being conducted by chemists in the Department of the Interior. The spectroscope has revealed a strong lithium line, indicating the presence of a valuable element whose presence was not previously suspected. Nickel is also plentiful, as is vanadium; it is even thought possible that the ashes of petroleum cokes may be utilized as future sources of vanadium and nickel.

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SCIENCE NEWS

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IMPROVED INCUBATORS

THE hen's efficiency in hatching eggs may at last be rivaled by the incubator, if work of a British electrical engineer, Llewelyn B. Atkinson, can be applied in commercial hatcheries. Mr. Atkinson believes that the missing link in modern incubation methods is that the eggs are heated too nearly alike on both sides. In the hen's nest there is from 14 to 20 degrees difference between the top of the egg, which is close to the hen's body, and the lower surface of the egg. With this apparently shiftless method of protecting the eggs, a setting hen hatches about 90 per cent. of her chicks, if she is ordinarily responsible and doesn't leave the nest or break the eggs.

Designers of modern incubators attempted to improve on the hen's system by heating the eggs about the same all over. Incubators sometimes make as high an efficiency record as that of the mother hen, but 60 per cent. is said by poultry experts to be average.

In the British experiment a thin sheet of india-rubber was placed like a blanket over the eggs. Mr. Atkinson reports: "This method produced very remarkable results. In an incubator which has rarely given above 55 per cent. of the eggs placed in it, this percentage was raised to over 95 per cent. of the fertile eggs."

Dr. M. A. Jull, poultry expert of the U. S. Department of Agriculture, says that the Atkinson experiments may have great significance to the American poultry business. Half a million or a million chicks are hatched each year in some of the mammoth commercial hatcheries in this country, and the baby chick crop turned out by American incubators probably exceeds 100,000,000. A 40 per cent. increase in efficiency would mean millions of dollars to the industry.

"One of the big factors of cost in the poultry business is the mortality of baby chicks," said Dr. Jull. "The results of Atkinson's experiments should be checked and tests made to determine their practical application."

PLANS FOR A GIANT WINDMILL

ANTON FLETTNER, the German inventor of the rotor ship, is planning a gigantic windmill designed on aerodynamical principles which will be some 300 feet in diameter mounted on a tower 650 feet high, higher than the Washington Monument and nearly as tall as the Woolworth Building.

This immense structure for obtaining power from the wind will not make use of the Flettner rotating cylinders, such as used on the rotor ships, but will have two large wings or propeller blades so constructed that they will obtain the most out of the moving air, according to the reports that have reached New York recently.

The famous Flettner rudder which is used in steering both ships and airplanes will be used to keep the propellers at the most efficient angle for the particular wind velocity. The cross-sections of the wings will resemble those used on airplanes and they will be designed so as to decrease to a minimum the air pressure on the rear side of the driving wing.

The proposed windmill is striking in size, but it is also unique in the method of generating power. Instead of having the large wheel geared to a single electric generator, it is planned to mount a small high-speed windmill on the tip of each propeller arm. These auxiliary windmills will actually generate the power by driving directly generators. Fletttner claims that the rotation of the large wheel will multiply the velocity of the small windmills ten times and that this will aid in the regulation of the voltage of the electric current obtained.

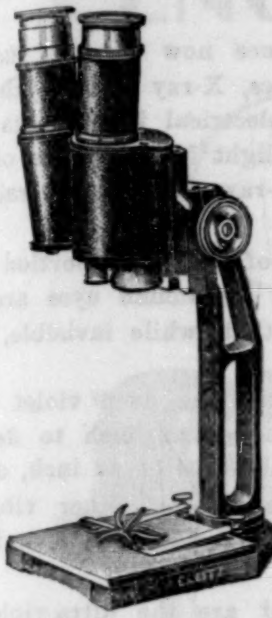
The huge structure that would support the 300-foot propellers presents a very difficult engineering problem and it is a problem of major design to make the windmill wheel itself structurally safe and strong. The reason for such a high tower is said to be that the winds are steadier at such heights.

No estimates of cost are contained in the information published in Germany, nor is it indicated whether actual construction of the windmill is contemplated.

THE STARS IN THE SPRING

SPRING began in the northern hemisphere on Friday, March 20, at 10:13 P. M., Eastern Standard Time, when the sun crosses the equator coming north. The sun will then be almost exactly in the zenith at a point in the East Indies where it will be noon at that instant. The dividing line between day and night will then pass through the north and south poles of the earth, and day and night will be equal in length all over the globe. As a result of refraction, however, the sun is elevated above the horizon by about a half a degree before it has actually risen and lingers in view for an equal period after it has actually set and the day is lengthened at the expense of the night. So, strictly speaking, day and night are not exactly equal in length when the sun is at the vernal equinox, at the beginning of spring, or six months later, when it is at the autumnal equinox, going south in September.

This effect of refraction upon the times of sunrise and sunset is most noticeable within the Arctic Circle where the sun is below the horizon for months at a time and where, when it does put in its appearance, it remains above the horizon for equally long periods. At the north pole, for instance, where the sun should make its first appearance on March 20, at the beginning of spring, it actually appears three days earlier as a result of refraction. For the same reason it remains above the horizon for three days after it has passed through the autumnal equinox in the fall when, theoretically, it should disappear from view for six months. This adds



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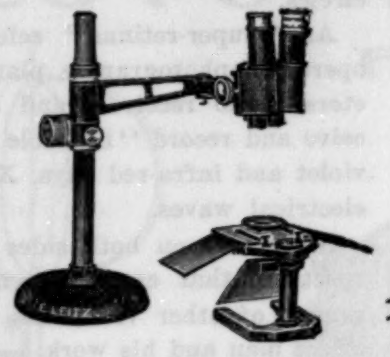

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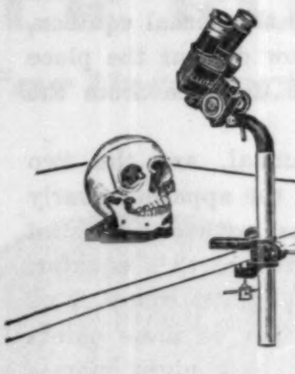

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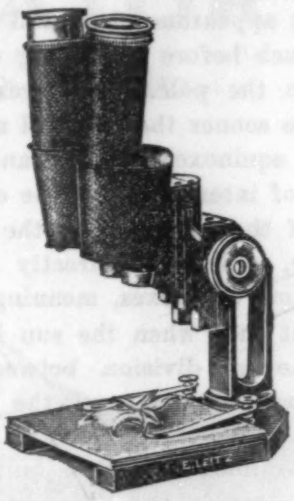

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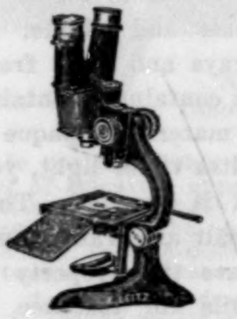

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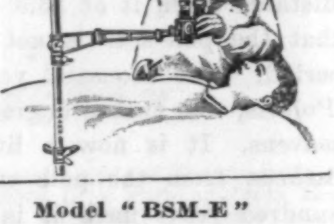

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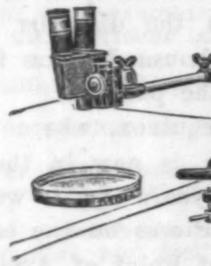

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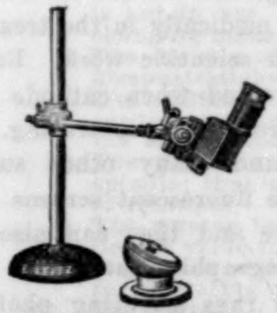

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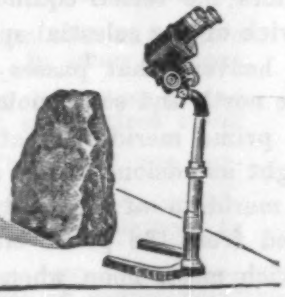

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in all, then, six days of much desired sunlight to the long polar day at the expense of the polar night. At other points within the Arctic Circle the sun will make its first appearance before it reaches the vernal equinox, how much before depending upon how distant the place is from the pole. The greater the distance from the pole the sooner the sun will appear.

The equinoxes, vernal and autumnal, are the two points of intersection of the ecliptic, the apparent yearly path of the sun through the heavens, with the celestial equator, which lies directly above the earth's equator. The name equinoxes, meaning equal nights, comes from the fact that when the sun is at either of these points the line of division between day and night passes through the poles and the two periods are equal in length.

The equinoxes, as it is quite generally known, are not fixed points in the heavens but are gradually shifting westward along the ecliptic. This westward motion of the equinoxes is called the Precession of the Equinoxes and it amounts to about thirty degrees in two thousand years, a complete circuit of the heavens along the ecliptic in 25,800 years. An attendant effect of the precession is the revolution of the north pole of the heavens around the north pole of the ecliptic in the same period at a distance from it of 23.5 degrees. It follows from this that the pole-star is not always the same during this period. Two thousand years ago our present pole-star, Polaris, was twelve degrees from the north pole of the heavens. It is now a little over a degree away. Its distance from the pole will decrease for the next two hundred years until it is within half a degree of the pole; then the distance will increase once more. About twelve thousand years from now the magnificent Vega will be the pole-star.

The vernal equinox, where the sun is at the beginning of spring, is now in the constellation of Pisces. Two thousand years ago it was in the constellation of Aries next to Pisces on the east. It then acquired its name of ''First Point of Aries,'' which it still retains. Sometimes the vernal equinox is also referred to as the Greenwich of the celestial sphere because the great circle of the heavens that passes through the vernal equinox and the north and south pole of the heavens is analogous to the prime meridian that passes through Greenwich. The right ascensions of the stars are reckoned from this prime meridian of the heavens just as longitudes are reckoned from the prime meridian of Greenwich. It is Greenwich mean noon when the sun is on the meridian of Greenwich and it is sidereal noon when the vernal equinox is on the meridian. The length of the tropical year—which is our ordinary calendar year—is determined by the time it takes the sun to pass from the vernal equinox in the spring back to the same position in the following spring.—*Isabel M. Lewis.*

"INVISIBLE LIGHT"

MUCH as man prides himself on his ability to see, his eyes are sensitive to only a very small portion of the ''light'' or ether vibrations constantly flooding the world.

For this reason reports from India that a scientist there has devised a ''super-retina'' of ''invisible light'' have not created great interest in American scientific circles.

As ''super-retinas'' science now has in successful operation photographic plates, X-ray screens, thermometers, radio receivers and electrical instruments to receive and record ''invisible light'' in the form of ultra-violet and infra-red rays, X-rays, heat waves, radio and electrical waves.

Stretching on both sides of the small portion of the spectrum that can be seen by human eyes are great ranges of ether vibrations that, while invisible, vitally affect man and his work.

Visible light, ranging from the deep violet with a wave-length of 16 millionths of an inch to deep red with a wave-length of 28 millionths of an inch, occupies only an octave of the spectrum of ether vibrations. Our eyes tell us what materials are opaque and translucent to visible light.

Shorter than visible light are the ultra-violet rays with wave-lengths from a millionth to 16 millionths of an inch. These rays affect photographic plates markedly and, in fact, much of the image in ordinary negatives is due to these rays which can not be seen by the eye. They have also been found to affect the growth and health of man, animals and plants. The sun's radiation is rich in these rays and light from mercury vapor lamps in fused quartz containers contains much of these wave-lengths. Most materials opaque to visible light are also barriers to ultra-violet light, yet ordinary window glass will not let it through. The minerals fluorspar, quartz and rock salt are transparent to ultra-violet. These rays also have the property of making some substances, finger nails for instance, glow with visible light.

The shortest waves known to man are the gamma rays of radium, given off when this wonderful chemical element spontaneously disintegrates. These are even shorter than the hard X-rays used medically in the treatment of cancers and tumors and in scientific work. Rays from radium and the X-rays created when cathode rays impinge on solid objects are very penetrating, passing through skin and flesh and many other substances. By allowing them to strike fluorescent screens they can be made visible to the eye and they can also be permanently recorded on photographic plates.

Between the ultra-violet rays affecting photographic plates and the X-rays lies a zone of ether waves but recently explored and little is known about them.

On the long wave side of visible light are the infra-red or heat waves. Many substances, such as water, easily penetrated by visible light are relatively opaque to infra-red rays and most of the hydrocarbons stop these wave lengths that range from 16 millionths to 12 thousandths of an inch. Thermometers record this sort of radiation and photographic plates specially treated with red-sensitive dyes can also be made to permanently record the infra-red.

Still longer than the infra-red rays are the Hertzian or radio waves used in wireless communication and

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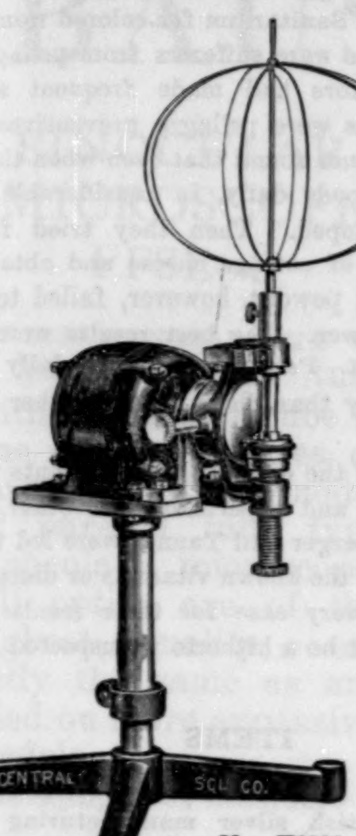
For the Lecture Table



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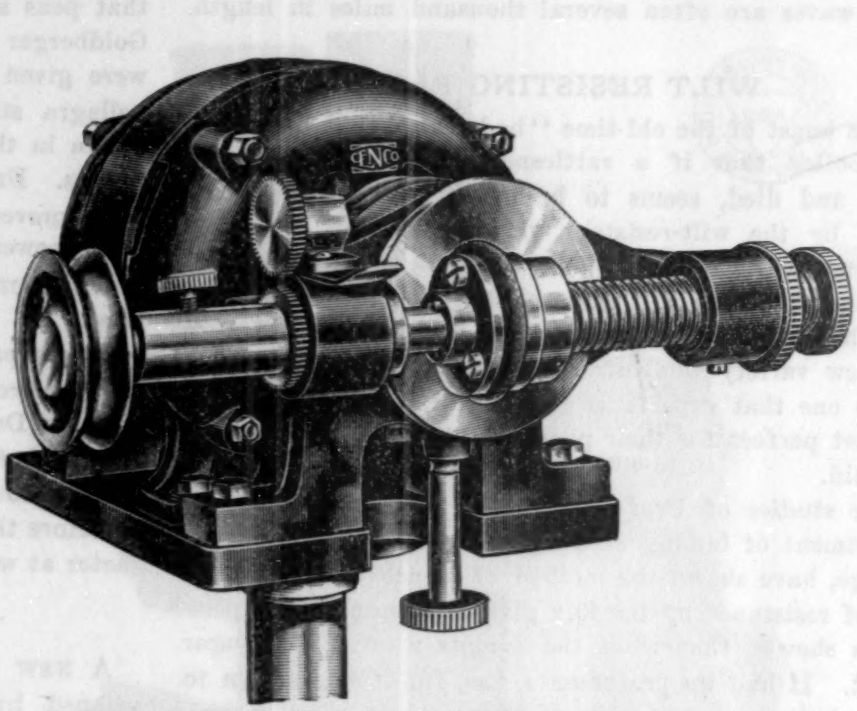

Enlarged View of Rotator of No. F1023, Showing Details of Speed Control Mechanism, Speed Counter and Pulley.

In designing this rotator we have brought together the points of view of the user and of the manufacturer of scientific apparatus. Thus full consideration was given to all requirements in a rotator from the point of view of both the instructor and the designer with the result that many excellent features were brought within the possibility of economical production. We enumerate below the most prominent features of design, the combination of which in a single rotator has been accomplished for the first time in the Cenco Lecture Table Rotator.

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Dimensions are as follows: Height over all above table, adjustable from 45 to 60 cm; table space occupied, 37 x 37 cm; power of motor, 1/10 h. p.; speed of motor, 1725 r. p. m.; diameter of pulley furnished, about 4.5 cm.

Complete as described, with socket, pulley and spindle with lock-nut for usual rotator accessories.

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broadcasting. These are received by wire and coils and may be rectified in such a way that they produce audible sound waves when conducted into telephone receivers. They range in length from a few meters or yards to many thousand meters or several miles.

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WILT RESISTING FLAX

THE boast of the old-time "bad man" that he was so hard-boiled that if a rattlesnake bit him it crawled away and died, seems to be made good in the plant world by the wilt-resistant variety of flax. For this disease-resistant plant actually seems to be able to poison the fungus of the wilt disease, that was rapidly wiping out the flax-growing industry of the northwest before the new variety was introduced, and the poison it uses is the one that experts in gas warfare dream about but can not perfect for their purposes—hydrocyanic or prussic acid.

The studies of Professor Ernest S. Reynolds, of the department of botany of the North Dakota Agricultural College, have shown the method of attack by the fungus and of resistance by the flax plant. Preliminary experiments showed that what the fungus wanted was sugar to eat. It had its preferences, too, for it was shown to thrive better on dextrose, or grape sugar, than on any other kind; and dextrose is the most abundant sugar in the flax plant. Next to dextrose it preferred sucrose, or common cane sugar, and then with diminishing zest, a number of other kinds of sugar.

To learn how the resistant flax defended itself against this enemy, Professor Reynolds grew cultures of the fungus, supplying them with various kinds of food and with extracts from both resistant and non-resistant flax plants. The fungus grew lustily on extract of non-resistant flax and it also grew well on extract of resistant flax that had been heated to sterilize it. But when extract of resistant flax that had been sterilized by passing through a fine filter without heating was supplied, the fungus growth was much depressed.

Professor Reynolds therefore concluded that there was some chemical compound in resistant flax that was poisonous to the fungus or that gave rise to a poison defense, and that it was good so long as it was not heated. This would indicate that it is an enzyme, for these compounds also are active until heated. Further work by Professor Reynolds showed that when a cell was crushed or penetrated, as by an attacking fungus thread, the enzyme was released, and acting upon certain organic chemical compounds present, generated hydrocyanic acid, which is a deadly poison; and this, naturally, brought the bandit fungus to a bad end.

THE CAUSE OF PELLAGRA

PELLAGRA, a disease of serious importance in the South, may be prevented by the newly-discovered "dietary factor P-P," present in brewers' yeast, fresh milk and fresh beef. While it may be a vitamin, it is not identical with any of the vitamins hitherto discovered and described. Drs. Joseph Goldberger and W. F. Tanner, of the United States Public Health Service, discovered this new disease-preventing factor while they were at work at the Georgia State Sanitarium for colored women, where many of the inmates were sufferers from pellagra.

Earlier investigators had made frequent statements that peas and beans were pellagra preventives but Drs. Goldberger and Tanner found that even when the patients were given these foods daily, in considerable amounts, pellagra still developed. Then they tried fresh milk casein in the form of cottage cheese and obtained good results. Dried milk powder, however, failed to have the same preventive power. The best results were obtained with brewers' yeast. Patients receiving daily doses improved more rapidly than those on any other treatment tried.

By comparison of the diets of their patients with those used in treatments and experiments on other deficiency diseases, Drs. Goldberger and Tanner were led to the conclusion that none of the known vitamins or dietary factors could account in every case for their results and that therefore there must be a hitherto unsuspected preventive factor at work.

ITEMS

A NEW kind of tarnish-resisting silver has been developed by a British silver manufacturing company. The material, which is 92.5 per cent. silver alloy, has been put to practical test by the manufacture of articles from it, and the results have been reported to the Silver Trade Technical Society. The new alloy is said to stand up to the heat necessary for soldering, and to keep shape while being heated. It will bear more heat than standard silver, and will allow of a considerable amount of manipulation without developing any defect. British housewives are following the experiments with interest in the hope that egg and fruit stained silverware will soon be problems of the past.

IN South Africa, where plagues of locusts are often fought with arsenic, it has been found that these insects, even though they have succumbed to deadly poison, can still be used safely for cattle food. Experts of the Department of Agriculture of the Union of South Africa have determined that in order to obtain a fatal dose of the poison cattle, sheep or horses would have to consume 200 to 700 pounds of the locusts, indicating that none of these animals are in danger from the poisoned insects. For poultry and pigs, however, there is not such a wide margin of safety.

SOME of our most beautiful ferns may fall under the ban which the government is placing on gooseberries and barberries, according to C. A. Weatherby, noted fern specialist. He reports that species of rust attacking balsam firs with destructive force are found to have ferns for their alternate hosts. Both eastern and western balsams are infected and ferns guilty of transmitting their disease are found on both coasts. Among them are the beech fern, the sensitive fern, the marsh fern, the western ladyferns, brackens and polypodies.

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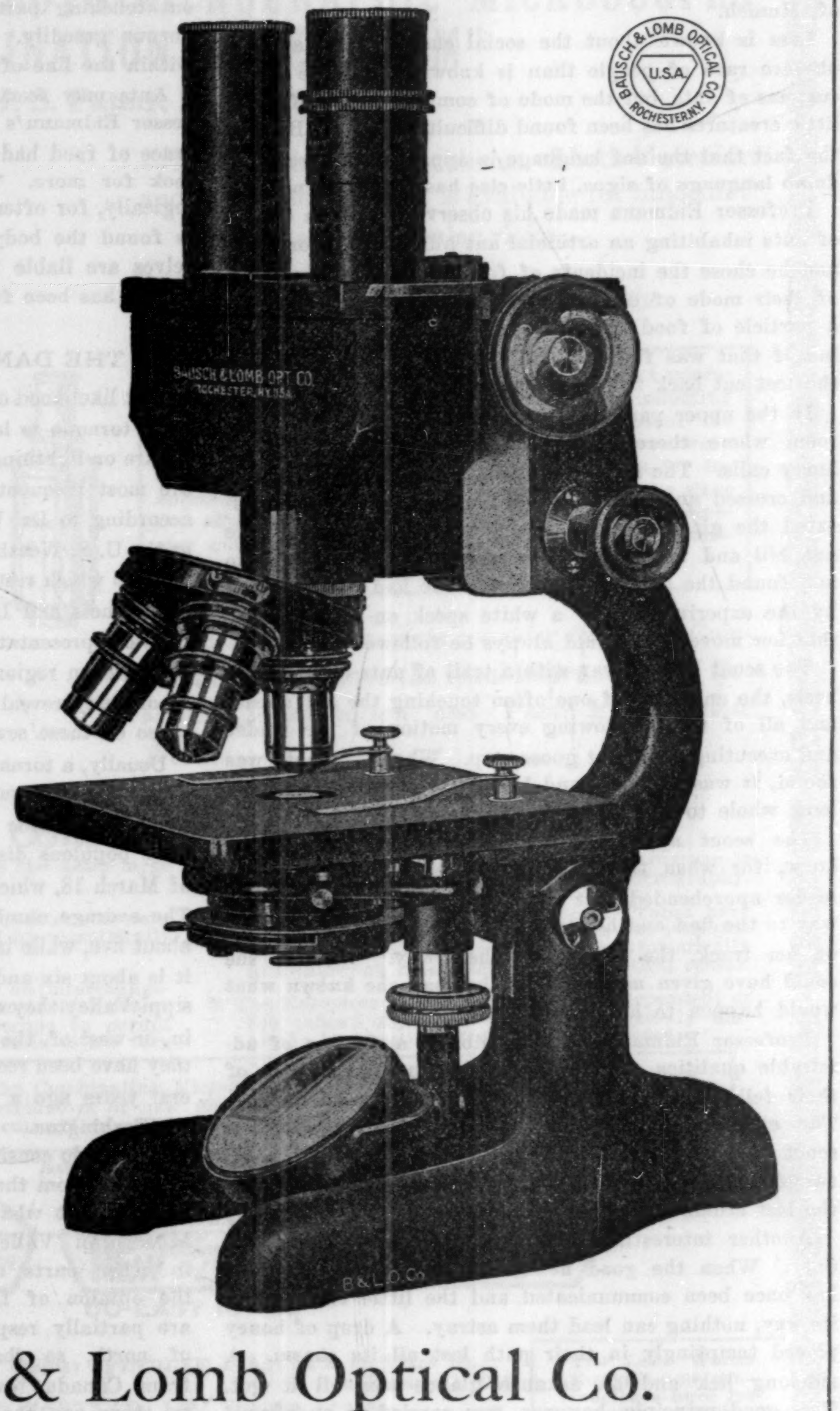

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SCIENCE NEWS

Science Service, Washington, D. C.

HOW ANTS COMMUNICATE

WHAT ants say to one another and how they communicate has been studied by Professor von H. Eidmann, of Munich.

Less is known about the social customs of many an obscure race of people than is known about the social customs of ants, but the mode of communication of these little creatures has been found difficult to study. Beyond the fact that the ant language is apparently a deaf and dumb language of signs, little else has been known.

Professor Eidmann made his observations on a colony of ants inhabiting an artificial ant hill in his laboratory, and he chose the incidents of food-finding for his study of their mode of communication. An ant upon finding a particle of food tried to drag it away all by herself, but if that was found entirely impossible, she took the shortest cut back to the ant hill to get help.

In the upper part of the ant hill was a sort of guard room where there were ants always ready for such hurry calls. The scout who had found the food entered and crossed antennae with each ant and thus communicated the glad tidings. The ants swarmed out of the ant hill and ran around aimlessly until the scout who had found the booty reappeared. She had been marked by the experimenter by a white speck on her back, so that her movements could always be followed.

The scout led the way with a trail of ants close on her heels, the antennae of one often touching the ant ahead, and all of them following every motion of the leader and executing a perfect goose step. When the booty was found, it was attacked and broken to pieces or dragged back whole to the hill.

The scout apparently did not tell everything she knew, for when the experiment was repeated and the leader apprehended just as she was about to direct the way to the find and her trail destroyed by putting paper on her track, the others lost their way. Whether she could have given more information had she known what would happen to her is not known.

Professor Eidmann's ants exhibited a number of admirable qualities. First of all, they never ask help of their fellows when they can do the job by themselves. The experimenter sprinkled crumbs of food where a scout could find them. The little creature made in all twenty-three trips back and forth to the ant hill until the last crumb had been delivered.

Another interesting quality is their strong sense of duty. When the good news of the discovery of food has once been communicated and the little troop is on its way, nothing can lead them astray. A drop of honey placed temptingly in their path lost all its charm. A sidelong lick and an askance glance was all it got. This good principle, however, was carried to an absurd extreme. Bigger pieces of better food were passed up because the ants did not know how to change their minds.

This trait explained something that had puzzled the experimenter for a long time. He had often noticed in nature that entire swarms of ants passed over without touching particles of food such as they generally devour greedily. This he now explains as being not within the line of duty.

Ants may seem to have short memories, but in Professor Eidmann's experiments, repeatedly, after the last trace of food had been carried off, the ants returned to look for more. This, however, can be explained biologically, for often where the head of a delectable insect is found the body may be somewhere about. We ourselves are liable to search carefully a spot where lost money has been found.

THE DANGER FROM TORNADOES

THE likelihood of a single house or barn being damaged by a tornado is less than its chance of being destroyed by fire or lightning, even in the districts where tornadoes are most frequent. Official statistics show such a risk, according to Dr. W. J. Humphreys, professor of physics at the U. S. Weather Bureau, in commenting on the severe tornado which resulted in hundreds of fatalities in southern Illinois and Indiana recently.

Two representatives of the Weather Bureau are now in the stricken region carefully studying the effects. Their report may reveal important information concerning the cause of these severe storms.

Usually, a tornado does not damage an area larger than a quarter of a mile in width and thirty miles long, so that great havoc is done only when this swath strikes some populous district. This was the case with the one of March 18, which passed over a number of large towns. The average number of tornadoes per year in Illinois is about five, while in Kansas, where they are most frequent, it is about six and a half. In other states in the Mississippi Valley they occur less frequently. They never occur in, or west of, the Rocky Mountains, but at rare intervals they have been recorded as far east as Virginia; and several years ago a mild one occurred within a few miles of Washington.

A tornado consists of a whirling mass of air which can even lift from the earth large objects coming within its grasp. Just what causes it, or why they occur in the Mississippi Valley and only on very rare occasions in other parts of the world is not known, but in the opinion of Dr. Humphreys, the Rocky Mountains are partially responsible. Their trend is slightly west of north, so that they tend to deflect cold winds from Canada towards the Gulf of Mexico. Opposed to them are the trade winds from the Gulf, which, unlike the Canadian winds, are warm and humid. Dr. Humphreys believes that the opposition of these two sets of winds gives rise to the conditions which cause a

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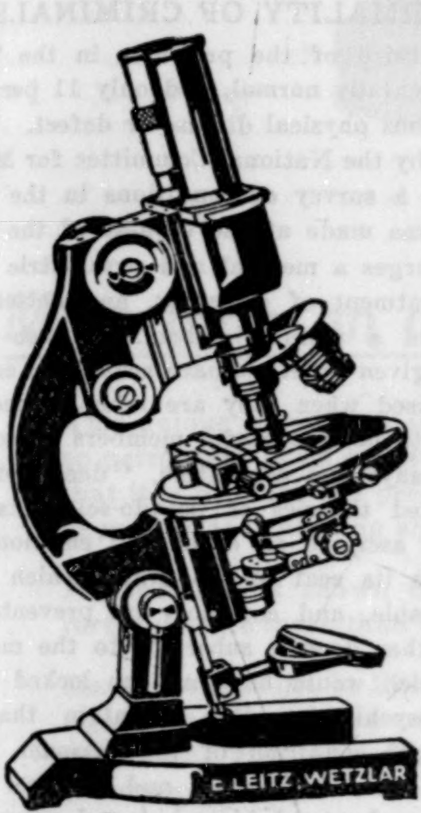

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4. **When either Binocular or Monocular Tubes have been inserted into the tube carrier, the patented clamping device arrests these tubes automatically in a thorough true position to the optical center.**
5. **The Nosepiece Adapter is mounted independent of the tubes; objectives remain permanently centered; irrespective of which tube is used.**

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The Leitz Works through new constructions have frequently caused a revolution in microscope models and optics.

tornado. He stated further that the Weather Bureau is able to predict in a general way the occurrence of a tornado, but that they can not predict the precise territory that will be affected. Therefore, in order to prevent the people in affected regions from becoming unduly alarmed, the bureau has made it a policy not to issue tornado warnings.

TUTTLE'S COMET

A FAINT comet which may, however, become bright enough within a few weeks to be seen by the unaided eye as a small patch of light, has been discovered by Professor Richard Schorr, of the Bergedorf Observatory, near Hamburg, Germany, according to advices received at Cambridge by Dr. Harlow Shapley, director of the Harvard College Observatory.

The celestial visitor is said to be Tuttle's comet which was first discovered in 1790 by P. F. Mechain at the Paris Observatory. After this, it was lost until 1858 when C. W. Tuttle, then at the Harvard Observatory, rediscovered it and found that it was periodic, returning to the neighborhood of the earth every fourteen years. Now it has returned for the fifth time since his observations.

At present it is of the eleventh magnitude, so that it can only be seen with the aid of a telescope of moderate power. It is in the constellation of the Sextant, below the bright star Regulus, which is directly south about eight o'clock in the evening. Regulus is at the end of the handle of the "Sickle," a group of stars in the constellation of the Lion resembling that gardening implement. The comet is moving towards the northeast so that it is coming into a better position for observation. As it is not a very large comet, however, and when nearest, is farther away from the earth than the sun, we will not get a very close view of it at the best.

THE ENGLISH PLANTAIN AND HAY FEVER

ENGLISH plantain, which, like the English sparrow, has become an agricultural pest in the United States, is now accused of making life miserable for a good many hay-fever victims. Dr. Harry S. Bernton, special expert of the U. S. Public Health Service, who makes the charge, reports that this weed has hitherto received only passing attention from American investigators of hay-fever causes.

In one case which he describes, a patient had suffered from hay fever for 13 years. He had been tested with pollen extracts from different grasses in the hope of gaining immunization from the disease, but apparently none of the grasses was the irritating agent. Dr. Bernton made cutaneous and intracutaneous tests with pollen from English plantain, and the itching, swelling and reddening of the skin showed that the irritating cause had been found. After treatment with the pollen extract, the patient was left 98 per cent. free of the disease.

English plantain has been recognized as a hay-fever plant of the first rank in Washington and Oregon, but in most sections of the country its possible importance has been overlooked. In the region of the District of Columbia, 16 per cent. of a series of patients subject to the vernal type of hay fever were found to be sensitive to the plantain pollen.

The U. S. Department of Agriculture says: "The English plantain, like the English sparrow, seems to stick closely to the thickly populated sections. It is found abundantly along streets in the outskirts of cities, on vacant lots and dump heaps, producing pollen in great abundance from about May 10 to August 1."

THE ABNORMALITY OF CRIMINALS

LESS than one third of the prisoners in the Texas penitentiary are mentally normal, and only 11 per cent. are free from obvious physical disease or defect. These facts are reported by the National Committee for Mental Hygiene following a survey of conditions in the penal institutions of Texas made at the request of the state.

The committee urges a medical and psychiatric clinic for study and treatment of offenders, and better hospital facilities and a training school. It also urges that prisoners be given indeterminate sentences, so that they may be released when they are rehabilitated and are judged ready to become useful members of society.

"Psychiatry," says the committee, "does not subscribe to half-baked theories of pseudo-scientists, like those who recently ascribed all crime to "emotional insanity" which has its seat in the brain, which is inherited and incurable, and can only be prevented by sterilization. Neither does it subscribe to the maudlin sentimentalism which would have no one locked up or punished. The psychiatrist does maintain that the mental and physical condition of the prisoner has a great deal to do with his conduct and that an effort must be made to understand his mind and personality before sound correctional treatment can be administered.

"Experts who have studied the penal situation believe that constructive criminology has reached such a knowledge of the criminal and his rehabilitation that we may safely and wisely make investments in buildings, apparatus and personnel. Additional expense in the interests of crime prevention is true economy in the long run."

The committee's report says that the majority of the Texas prisoners are under 30 years of age and that much can be done to remold the personalities of young offenders into socially acceptable forms.

THE BEE-LOUSE

PRESENCE of the bee-louse in this country has attracted the attention of the U. S. Bureau of Entomology. The bureau reports the need of scientific study of these microscopic stowaways which sometimes slip into the United States on the bodies of queen bees arriving from Europe.

The "cooties" which make life miserable for queen bees, and to a less extent for workers in the hive, are less than six one hundredths of an inch long, according to Dr. E. F. Phillips, government specialist on bees. They are hairy little monsters with flattened heads and no wings. Each leg is equipped with a set of about 30

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teeth, like modified claws, and by means of these claws the bee-louse clings to the hairs of the flying honeybee and travels through the air in safety.

Dr. Phillips says that the pests have not been studied extensively and that scientific opinions regarding them differ. It is fairly well settled that the bee-louse was misnamed, as it apparently is not a bloodthirsty parasite, but rather a "guest" insect.

M. Perez, a French scientist, who observed infested bees, reported: "When the louse wishes to feed it goes to the bee's mouth, where the motions of its feet, armed with bent claws, produce a tickling sensation, perhaps disagreeable to its host, but at least provoking some movement of the buccal organs, which slightly open and release a small drop of honey which the louse at once licks up."

Dr. Phillips does not anticipate that this pest will greatly harm American apiaries, but he says that its establishment in this country is unfortunate and that its importance should not be underestimated. "With such a visitant of the bee colony," he adds, "it is impossible to determine in advance what effect it may have in some other portion of the country, and every means should be taken to eradicate it, especially since the infested area seems to be small at present."

MONGOLOID IDIOTS

THERE are about 20,000 Mongoloid idiots in the United States, and these defectives that look like Oriental dolls are increasing, according to Dr. Noble P. Barnes, of Washington. The condition, which is attributed to defective glands, is more prevalent in France, due, it is thought, to endocrine exhaustion of the race.

"These cases may occur in our best families," says Dr. Barnes. "Education, culture and refinement do not insure stability of the endocrine system, but tend rather to exhaust these vital forces."

The Mongoloid child has a small, flat nose, and the face has the appearance of having been "pushed in." Its hair is straight, thin and usually dark. Arms and legs are short, and when the child learns to walk alone, at the age of four or five years, the characteristic gait is shuffling. The Mongoloid is a good-natured idiot, whose smiling face suggests "the possession of a secret source of joy."

An outstanding defect in the Mongoloids studied by Dr. Barnes is a disordered thymus gland. A large amount of phosphorus is needed by the body during early years of life, and according to a current theory the thymus has the important function of supplying this excess of phosphorus. When its work is completed, the thymus is retired, so to speak. The reason for the Chinese features of the white Mongoloid idiot has been ascribed to the fact that oriental diet is low in phosphorus. It is suggested that a long period of dietetic errors in the ancestry of the child is the cause of gland disturbance resulting in Mongolism, Dr. Barnes says.

"The Mongoloid has a defective protective organism and is easy prey to bacterial infections," he explains. "Such persons rarely live to be 20 years old, and the majority die before their cases are ever diagnosed." Doses of thymus and other selected glands are being given to such children with encouraging results, he reports. One Mongoloid studied and treated from infancy succeeded in completing a high school course, in spite of congenital disease and other handicaps, but this patient succumbed to illness a few years later."

ITEMS

WORD has just been received of the discovery of the largest fossil dinosaur bones on record, by an expedition under W. E. Cutler, of the British Museum, which has for the past year been working in the dinosaur beds in Tanganyika, formerly German East Africa. The prize find so far uncovered is a shoulder blade six feet two inches across. The dinosaur beds of Tanganyika were discovered and partly worked by the Germans before the war, and many interesting remains have been found there. There is a close resemblance between the dinosaur fauna of Africa and that of western North America, especially in the case of the Stegosaurs or armored dinosaurs. Even the newly discovered giant has American kin, though this particular dinosaur is represented in American finds only by two limb bones.

FRIDTJOF NANSEN, the famous Arctic explorer, is returning to the North Pole country after nearly thirty years spent in other work. He has announced that he is to head a German expedition which will make a long flight across the polar regions in a specially constructed dirigible of 5,000,000 cubic feet capacity, or something like twice the size of the "Los Angeles." A crew of fifty men will be carried, and the flight from the Murmansk coast, north of the White Sea, to Alaska and back is expected to occupy four weeks. The principal objectives of the voyage will be scientific. Photographs to become bases for maps of the Arctic regions will be taken, soundings made in the ocean, and other data assembled. It is hoped that the expedition will be able to start in 1927.

CHILDREN with normal eyesight or with moderate defects see better as they grow older. Snellen's eye test given to 9,245 children showed that the percentage of children with normal vision increased as the children grew older and the percentages of those with minor defects decreased. The number of children with markedly defective vision increased, however, with age. Of all the children tested, 63 per cent. were found to be normal, 27 per cent. moderately defective, and only 10 per cent. had poor eyesight. The percentage of boys with normal eyesight was slightly higher than the girls, but the average for those with very poor vision was the same.

MAKING synthetic rubber has resulted in the discovery of a synthetic chemical substitute for cocaine. Tutokain, the new compound, is made from the intermediate products which have been prepared in the manufacture of artificial rubber. The sale of cocaine has been discouraged in Germany because of its habit-forming characteristics. Tutokain is non-poisonous and may be sterilized by heat without decomposition. According to articles in the medical press, it has been used with great success as a local anesthetic.

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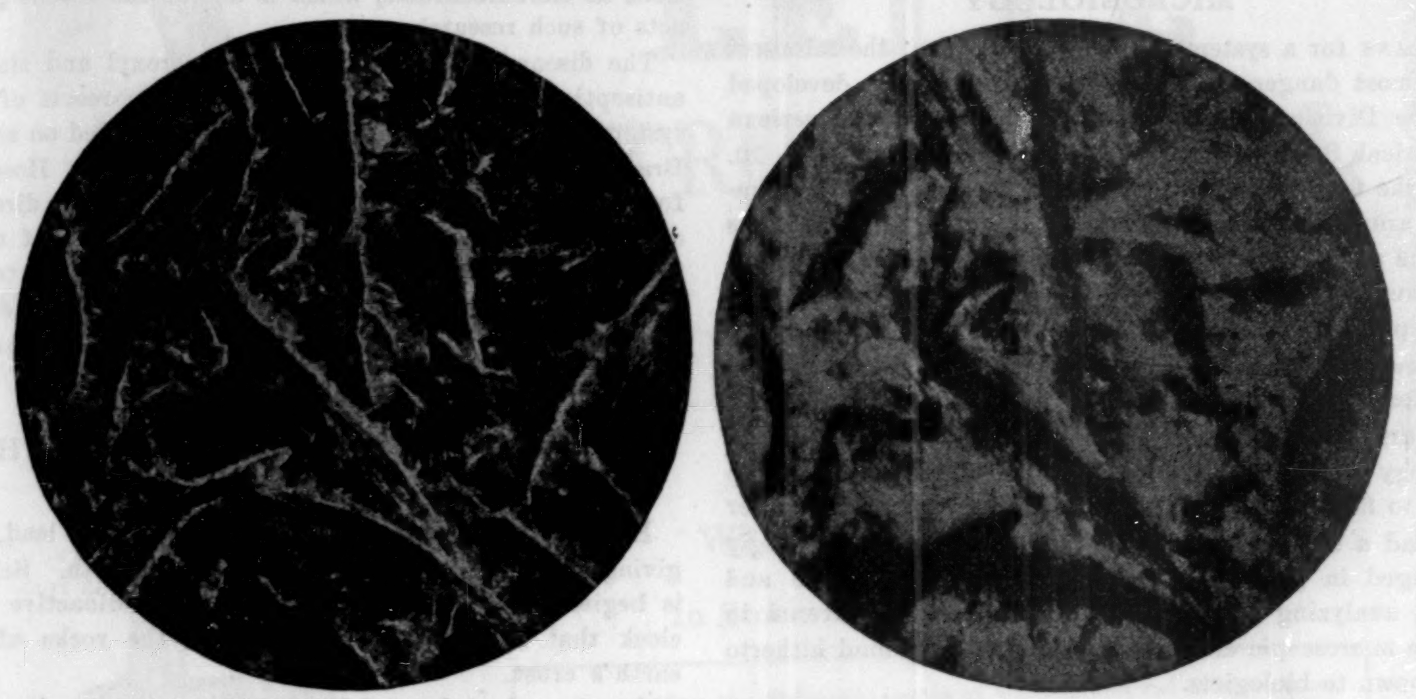

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SCIENCE NEWS

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CHEMISTRY IN THE FIELD OF MICROBIOLOGY

PLANS for a systematic campaign against the minutest and most dangerous enemies of mankind were developed in the Division of Medicinal Products of the American Chemical Society in session at Baltimore on April 10. For the first time in the history of the healing art, chemists are cooperating with bacteriologists and physicians in the effort to make compounds that will be harmless to the human body and yet will poison or paralyze the noxious plant and animal parasites that prey upon it.

New tactics are being employed in this campaign. Professor Treat B. Johnson, of Yale University, in opening the symposium on "Chemistry in the field of microbiology" advanced the novel idea that the first step was to find out what the microbes were made of in order to find a drug that would kill them. He is accordingly engaged in growing tubercle bacilli by the pound and then analyzing them, and he has already discovered in these microscopic creatures a nitrogen compound hitherto unknown to biologists.

Dr. Carl Voegtlin, of the Hygienic Laboratory of the U. S. Public Health Service, is working on organic compounds containing arsenic in order to discover one that will penetrate the human tissue in pursuit of the parasite more freely than the earlier arsenicals introduced by the late Professor Ehrlich, of Germany. He reports that it is possible to produce a peculiarly active form of arsenic that will attack the mechanism by which the microbes breathe.

Dr. John W. Churchman, of the Loomis Laboratory, New York City, finds that certain of the aniline dyes will attack and paralyze particular species of bacteria so they can be used as antiseptics, both for skin wounds and internal infection. Solutions of these dyes strong enough to check infection may be left in cavities, such as the joints, since they are too weak to damage the tissues. He thinks it not improbable that we shall soon be able to combat many cases of blood poisoning successfully.

Dr. Veader Leonard, of the Johns Hopkins University, has made a new antiseptic that promises to be of great value. It is a derivative of the familiar coal-tar compound, resorcinol, and is called "hexyl-resorcinol." This is more than 15,000 per cent. stronger as a germicide than the mother substance, resorcinol, yet is probably less poisonous. The new compound is excreted through the urinary tract so is likely to serve as a cure for infections of this region.

Professor George W. Raiziss, of the University of Pennsylvania, has prepared chemically and investigated biologically a number of new dyestuffs containing mercury and has found two which are so much less toxic than the common mercury bichloride that they may be injected directly into the blood. In tests on rabbits they were found to be as curative against blood infections as mercurochrome, which is one of the recent products of such research.

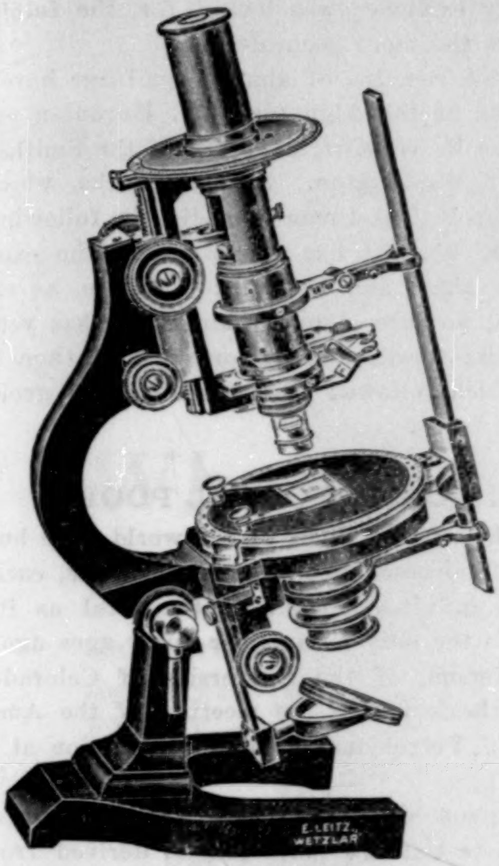
The discovery of mercurochrome, meroxyl and similar antiseptics was no lucky accident but the result of the systematic investigations that have been carried on at the Brady Urological Institute of Johns Hopkins Hospital for the last eight years. Dr. Hugh H. Young, director of the institute, reported that in the progress of these investigations 265 dyestuffs had been studied and tested for their power of destroying germs and several drugs had been found among them that are useful as remedies for local or general infection.

RADIOACTIVITY AND THE AGE OF THE EARTH

EXPLODING atoms, changing uranium into lead, are giving geologists a clew to the age of the earth. Science is beginning to learn how to read the radioactive time clock that is contained in many of the rocks of the earth's crust.

An age of at least 1,250,000,000 years has been assigned to the earth by experiments reported to Professor A. C. Lane, of Tufts College, chairman of the committee of the National Research Council on estimation of geologic age by atomic disintegration, which is carrying on extensive investigations. Dr. H. V. Ellsworth, of the same committee and of the Canadian Geological Survey, Ottawa, has made analyses of the original crust of the earth in the Canadian region, and the relative amount of the radioactive elements and the lead decomposition products indicates that those minerals date back a billion and a quarter years in that region. Professor Lane, in a report to the Canadian Mining Institute, called attention to this method as about the only way of safely matching beds and determining their order in the early days before there were any well marked fossils, in the ages which he calls "collozoic" because the animals may have been but jelly. Of course even these immense stretches of years do not go back to the time when the earth was molten, and Dr. T. C. Chamberlin, of the University of Chicago, has doubted if it ever was. But Dr. Lane has pointed out a possible way of figuring how long ago it was if it was.

The lead derived from radium, while indistinguishable in every other way from ordinary lead, is slightly lighter, the weight of its atom being 206 while that of ordinary lead is 207.18. On the other hand, thorium also yields lead which has a little greater weight, say 208. Now why should not lead from different places have more range in weight? Dr. T. W. Richards, of Harvard University, the famous chemist and Nobel prize winner, has suggested that ordinary lead dates back to a molten earth, and generally speaking that it was the mixing that then took place which makes the atomic weight so



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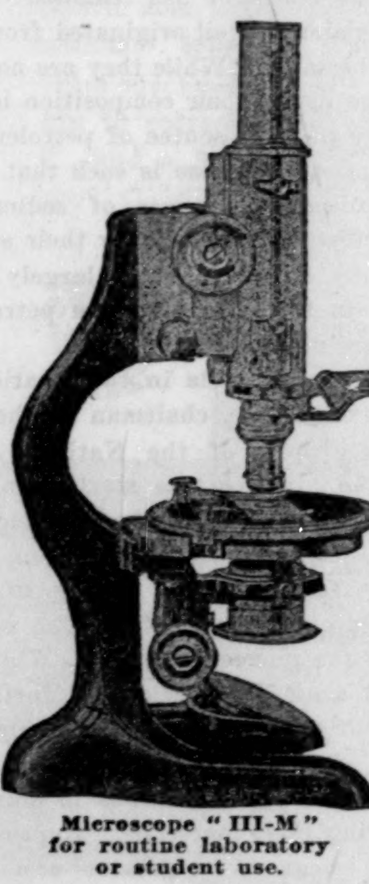

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uniform. Kirsch, the geologist, has suggested that both thorium and radium are produced from uranium but at different rates.

Dr. Lane believes that if Kirsch and Richards are right, some 240 million years earlier than the earliest known mineral cited by Kirsch the uranium must have contained the atoms changing to thorium and to uranium in such proportions that they would give ordinary lead, so that if ordinary lead was formed that way the molten condition of the world antedates the ancient granites of moss in south Norway about a quarter of a billion years.

Even these are not the earliest minerals known; yet, making some allowance for lead not so derived, it is assumed that they are 900 million years old. Thus geologists can say that there is no reason to believe the earth crusted over less than 1,100,000,000 years ago.

On a recent trip to Europe, Dr. Lane secured chemical analyses which show that the Katanga region of Africa which is now producing radium and copper at low cost is twice as old as the last time of geologic upheaval in the Appalachian region of the eastern United States and half as old as some Canadian rocks. He believes that radioactive methods of setting the ages of rocks will unravel the structure of ore depositing intrusive rocks in Canada which now lead the world in silver and nickel production and are overtaking the Rand in gold.

FOSSIL REMAINS IN THE ARCHAEAN ROCKS

PROOF that life existed on the earth when the oldest of known rocks were formed is claimed by Dr. John W. Gruner, of the department of geology of the University of Minnesota. He has shown traces of blue-green algae, very primitive microscopic plants, to be present in rocks of the age known to geologists as Archaean, which have hitherto been thought to be devoid of all fossil remains. In the past, indeed, many geologists believed that most of the Archaean rocks were formed by direct cooling of a molten earth, which would, of course, have meant a temperature too high for the existence of any life.

The rocks in which the new life traces were discovered have in the course of ages been subjected to immense pressures, partial solutions and recrystallization processes, to such an extent that the exact nature of the plant remains can not be stated with certainty; but botanists at the university have no doubt that they were some kind of algae. If they were algae of the blue-green type, there is still a possibility that they may have existed in a very warm environment, for plants of this kind still live in the nearly boiling natural waters of Yellowstone Park and other hot springs regions; though blue-green algae are also common in water of ordinary temperatures.

Because of the fact that most of the oldest fossils hitherto known, from rocks much younger than the Archaean, were of animals and plants relatively high in the evolutionary scale, biologists and geologists have long predicted on theoretical grounds that simpler remains would some day be found in older formations. Dr. Gruner's find is therefore looked upon as an interesting confirmation of this scientific prophecy. And inasmuch as blue-green algae were among the plants whose probable early existence was looked for, the fulfillment is regarded as the more accurate.

Other organic remains of almost equal age have been found in rocks of the Algonkian and Huronian periods by Dr. Charles D. Walcott, secretary of the Smithsonian Institution of Washington. In these rocks, which belong to the geological times immediately following the Archaean, Dr. Walcott has demonstrated the existence of blue-green algae and bacteria; but here, as also in the Archaean, no sure sign of animal life has yet been found. Animal fossils appear for the first time in the Cambrian, which followed these three earliest geological epochs.

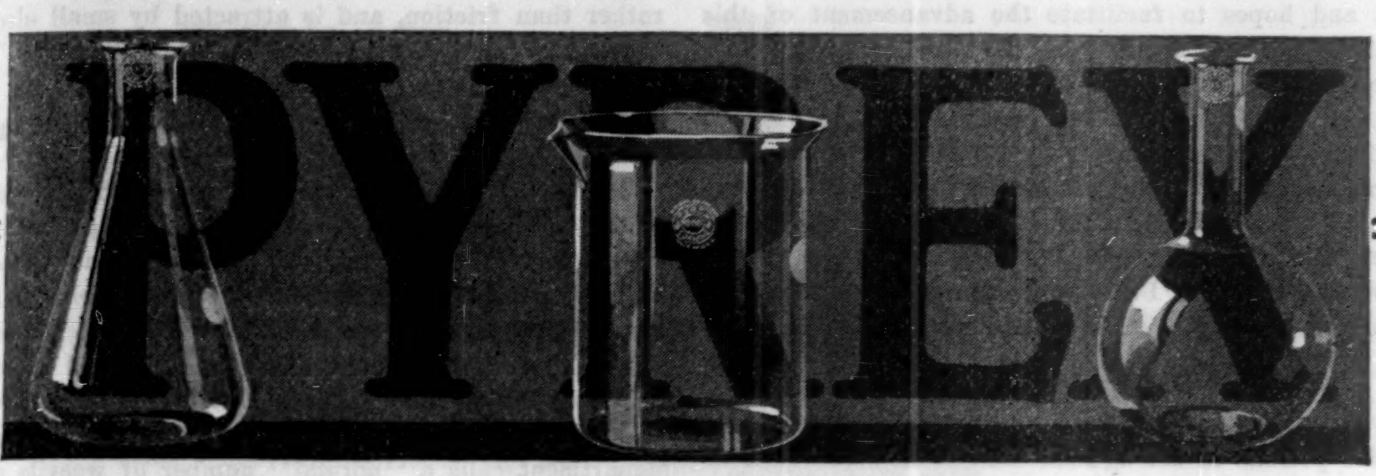
THE ORIGIN OF OIL POOLS

MOST of the vast oil pools of the world were built up by swarms of microscopic plants and animals, each contributing its infinitesimal bit to the total as it died and settled to the oozy ocean floor many ages ago. Dr. Junius Henderson, of the University of Colorado, advanced this thesis before the meeting of the American Association of Petroleum Geologists in session at Wichita, Kansas.

Dr. Henderson discounted the theory advanced by some geologists that all petroleum is derived from the remains of fishes, overwhelmed in shoals by great showers of volcanic ash, as both insufficient and unnecessary to account for the presence of oil. He pointed out that while fish bones and scales are frequently found associated with oil deposits, such deposits are also frequently found with no traces of fish remains.

In defense of his claim that oil originated from minute plants and animals, he said: "While they are not usually so rich in oil as some fishes, their composition is such as to make them a quite possible source of petroleum under favorable circumstances, their size is such that they are easily buried by ordinary processes of sedimentation, their prodigious numbers compensate for their small size, and they are actually found to enter largely into the composition of certain formations rich in petroleum, in which fish remains are uncommon."

How the study of fossils aids in the location of oil was told by Dr. David White, chairman of the division of geology and geography of the National Research Council. Though the practice was started only a few years ago, many oil companies now have paleontologists on their staffs whose studies of fossils, often of microscopic size, greatly facilitate the finding of oil and saves the boring of many useless holes. The work, however, is still only in the pioneer stage, Dr. White stated. Many of the men at work in the field need further training, and almost all of them are handicapped by the lack of proper libraries of reference books and by the difficulty of getting at the large collections in museums for purposes of comparing their materials. Improvement in these respects will mean even greater economies, he stated. He announced also that the National Research Council is preparing a directory of all students and



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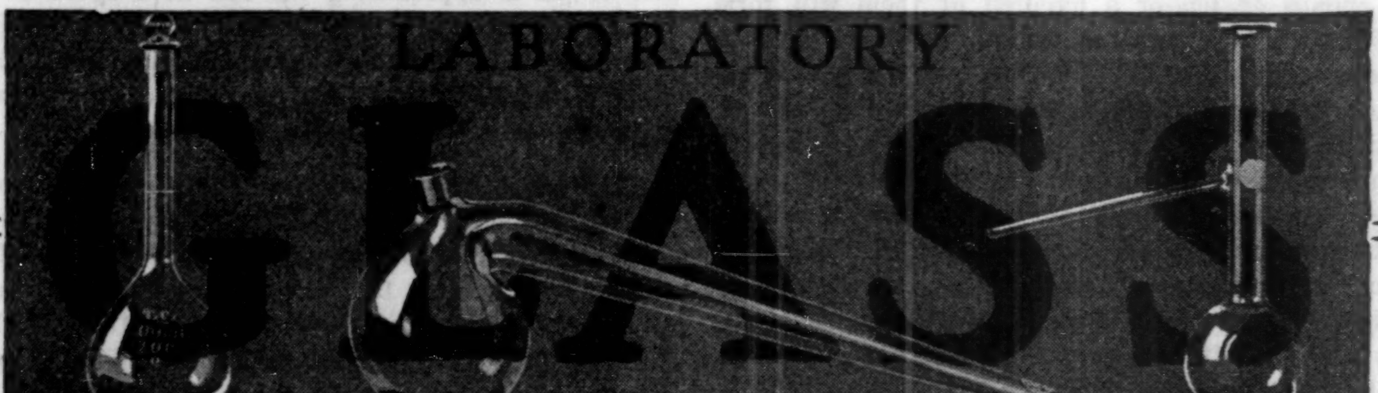

specialists working on small fossils found in the oil fields, and hopes to facilitate the advancement of this branch of oil work by making the work of experts and the facilities of libraries more available to field workers.

Dr. W. A. J. M. van der Gracht, of Houston, discussed his geological studies in the High Plains region of western Texas. He has found in this region continuations of geological formations of the highlands of the eastern United States and Canada, which are lost in intervening regions. Parts of these regions contain gas and oil deposits of considerable promise.

INSECT WARFARE

GOVERNMENT research workers seeking for the most effective poisons to use against the cotton boll weevil of the South, the alfalfa weevil of the West and others of the horde of insect pests everywhere, have found themselves confronted with some pretty problems in electrical physics. The Bureau of Entomology and the Bureau of Standards are now cooperating in an endeavor to find cheaper and more effective methods for insect warfare by solving some of them.

The antics of the minute particles in the dry poison dusts that are used against the boll weevil and other pests furnish a very interesting electrical puzzle. Some time ago it was found that a fine dry dust of calcium arsenate or other poison would stick to leaves just about as well as a liquid spray. It was cheaper to apply the poisons in this way, and for some purposes more effective as well. But poison dusts have been found to vary considerably in the thoroughness with which they cover the leaves, and also in the length of time they will stick before being blown or washed off.

It has been suggested that static electricity is at the bottom of this behavior. As the microscopic particles of the poison dust, some of which are as small as five microns or one five thousandths of an inch, in diameter, swirl through the nozzle of the spray gun the friction apparently gives them an electrical charge. "Like charges repel; unlike attract," says the old rule. If the particles receive similar charges each one will push its neighbor away and "flock by itself." This will result in an even distribution of the poison dust over the plants, so that each weevil will have a chance to get the fatal mouthful he is entitled to. But if the particles receive mixed charges the opposites will attract each other, and little clumps of ten or a hundred of them will form, resulting in an uneven distribution. Obviously, the desirable thing is to devise apparatus that will give a uniform charge to the particles, and thus get thorough distribution of the poison at lower cost.

Another suggestion is that the natural electrical charge of the earth, which extends into the plants as into a sort of antennae, attracts and holds the particles if they happen to bear an electrical charge of opposite sign. However, investigators of the Bureau of Standards, while they admit the possibility of this phenomenon, are not inclined to make much of its importance.

The behavior of the minute droplets of liquid sprays also is controlled by electrical charges, but in a somewhat different manner. The liquid drop acquires its charge by the chemical action of the dissolved arsenic compound rather than friction, and is attracted by small electrical charges in the living parts of the plant itself.

The summer campaign of the boll weevil is being eagerly studied and anticipated by government specialists and by the cotton industry.

Agents of the Department of Agriculture have collected 6,500 pounds of Spanish moss from plantations in Louisiana, South Carolina and Georgia, and have carefully counted the weevils that survived the winter in the moss. Last summer was so hot and dry that few weevils raised the usual large families, but many of those that survived the summer spent a fairly comfortable winter in their hibernating quarters. Consequently, what the department calls a "normal" number of weevils are on hand to start the season in the southeastern states. From Alabama westward the infestation this year is expected to be fairly light.

However, these records are merely indications of what may be expected, and do not represent in any way the final damage which may be expected for the season. The weather, which is a big, unforeseeable factor, may change the outlook entirely.

Conditions last year were so favorable to the cotton growers that many farmers have concluded that weevil control measures are no longer necessary, that the pest is at last conquered. This feeling will surely result in disaster if it persists, representatives of the department believe. The cold winter and hot summer of last year and the activity of the leafworm which starved out so many weevils represent a combination of circumstances which is not likely to recur in many years. Farmers are being urged to lay in an advance supply of calcium arsenate and of necessary machines for applying it, so that the weevil hordes may be attacked when the squares of the young cotton appear.

ITEMS

WHAT may be a genuine companion to the sun has been discovered in the constellation of Taurus, the Bull, according to a study by Dr. W. J. Luyten, of the Harvard College Observatory. The star, which is known as 46 Tauri, and just barely visible to the unaided eye, has been observed at the Lick Observatory in California, and the Dominion Astrophysical Observatory at Victoria, B. C. It is approaching the sun at a speed of about half a kilometer per second, which is a very slow velocity, astronomically speaking. As its motion across the sky is also relatively slight, it is believed to be moving through space with the sun.

THE government exploration party which is traveling to the northern wilderness of Alaska in order to chart the oil resources of Naval Petroleum Reserve No. 4, has made the first 150 miles of its dog team journey, according to telegraphic advices to the U. S. Geological Survey. The party, which consists of Gerald Fitzgerald, topographer, Walter R. Smith, geologist, and two assistants, still has 500 miles to go over the mail trail before striking off into the wilderness at the top of the continent.

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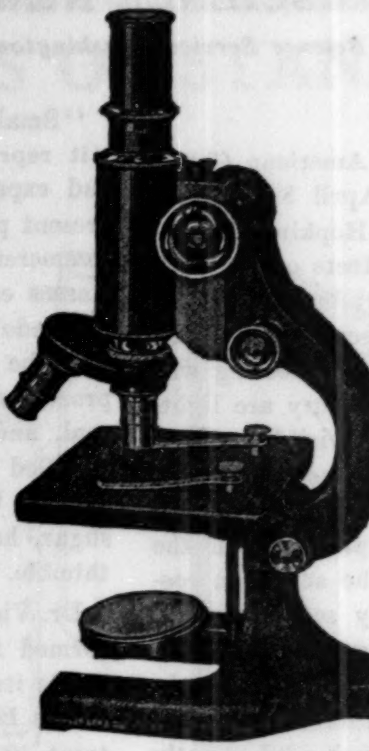

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SCIENCE NEWS

Science Service, Washington, D. C.

INVISIBLE LIGHT

A LARGE audience of members of the American Chemical Society meeting in Baltimore on April 8 saw and heard Professor R. W. Wood, of Johns Hopkins University, demonstrate some of the strange effects of invisible light. Eyes, teeth, finger nails and shirt buttons of the audience glowed with a pale, phosphorescent light when the illumination of the theater in which the meeting was held was extinguished and a powerful mercury arc light, rich in the invisible ultra-violet rays, but visible only as a faint purple, was directed toward the assemblage.

This phosphorescence of various substances under the ultra-violet rays has already found application on the stage, Dr. Wood said, for by dressing the actors in costumes of material readily affected, they seem to glow. Scenery so treated has also been employed, and by mixing various visible colors with ultra-violet, the same background may be made to appear vastly different.

Dr. Wood said that ultra-violet rays were used secretly during the war for invisible signalling at night. The rays were focussed and directed in the same manner as ordinary light in a searchlight, but the invisible light could only be detected through the use of the proper detecting apparatus.

Ultra-violet rays are like those of ordinary light except that the waves of which they consist are shorter than those of violet light, the shortest that we can see. Red light is the longest of the visible rays, and beyond them are the infra-red, also invisible but with very different properties from the ultra-violet. They do not have the power of inducing phosphorescence, but they do have the peculiar property of passing through mist and water vapor, a property used to advantage last summer in making photographs of Mars when it approached close to the earth.

Photographs were made of Mars with filters which transmitted only the infra-red rays, the chemists were told, and it was found that details on the surface of the planet were brought out which were quite invisible in pictures made with visible and with ultra-violet light. Further, the diameter of the planet in the infra-red pictures is appreciably less than in the others, so that astronomers have concluded that the presence of an atmosphere is indicated. These experiments were similar to some made several years ago by Dr. Wood, when he photographed the moon in a similar way.

RADIUM AND RADON

LESS than a half pound, between 200 and 220 grams, of radium has been produced in the world since Madam Curie discovered this precious element in 1898, Dr. Charles H. Viol told members of the American Chemical Society meeting in Baltimore. Dr. Viol is director of the Radium Research Laboratory of the Standard Chemical Co., of Pittsburgh, which has produced nearly half of the entire supply.

"Small as this quantity of material is," said Dr. Viol, "it represents an almost unbelievable amount of work and expense in the refining of the radium and at the present price represents a total value of $15,000,000. Its commercial production entails the handling of enormous masses of minerals. When carnotite from southwestern Colorado is used as the source, more than 500 tons of ore must be handled to yield one gram of radium. In this process a like tonnage of chemicals, a thousand tons of coal, and upwards of ten thousand tons of treated or distilled water are used—the final product being pure radium bromide, a white powder resembling powdered sugar, having a bulk sufficient to half fill an ordinary thimble."

Dr. Viol demonstrated radon, which is continually being formed from radium, but is 160,000 times more active. While its price per weight is much greater than radium, it has been found that $25 to $50 worth of radon will treat conditions requiring $2,000 to $4,000 worth of radium. However, it loses half of its activity in about four days, he said, so that it can only be used for a limited number of patients, while radium may be used repeatedly. The small bulk of radon, however, is an advantage, for the tiny tubes containing it may be imbedded directly in a tumor mass, so that all the radiations are utilized in the destruction of the growth.

A NEW ANESTHETIC

PROPYLENE, a gas closely related to ethylene, whose usefulness as an anesthetic was one of the sensational medical discoveries of the past year, has been found to possess similar powers, of such high quality that it may rival or even supplant its sister compound. Its properties were described before the American Chemical Society, by Dr. Lloyd K. Riggs and Harold D. Goulden, of the research laboratories of E. R. Squibb and Sons, at New Brunswick, N. J.

In the course of the experiments, in which large numbers of rats were used, it was found that a mixture of 70 per cent. of propylene with 25 per cent. oxygen and 5 per cent. nitrogen rendered the animals insensitive to pain in one minute and caused them to relax into complete unconsciousness in two. Used too long, propylene is poisonous, but there is a wide margin of safety, for about sixteen minutes' time was required before the rats' respiration failed, under the conditions of the experiment.

No long-range ill effects were observed to follow the use of the gas. A number of female rats were experimented with specifically on this point; and although they were used day after day in the tests they remained in good health, gained weight rapidly, and bore litters of normal young. As a consequence of their experiments, the investigators recommend the clinical use of propylene.

Propylene, like ethylene, is an ingredient of common

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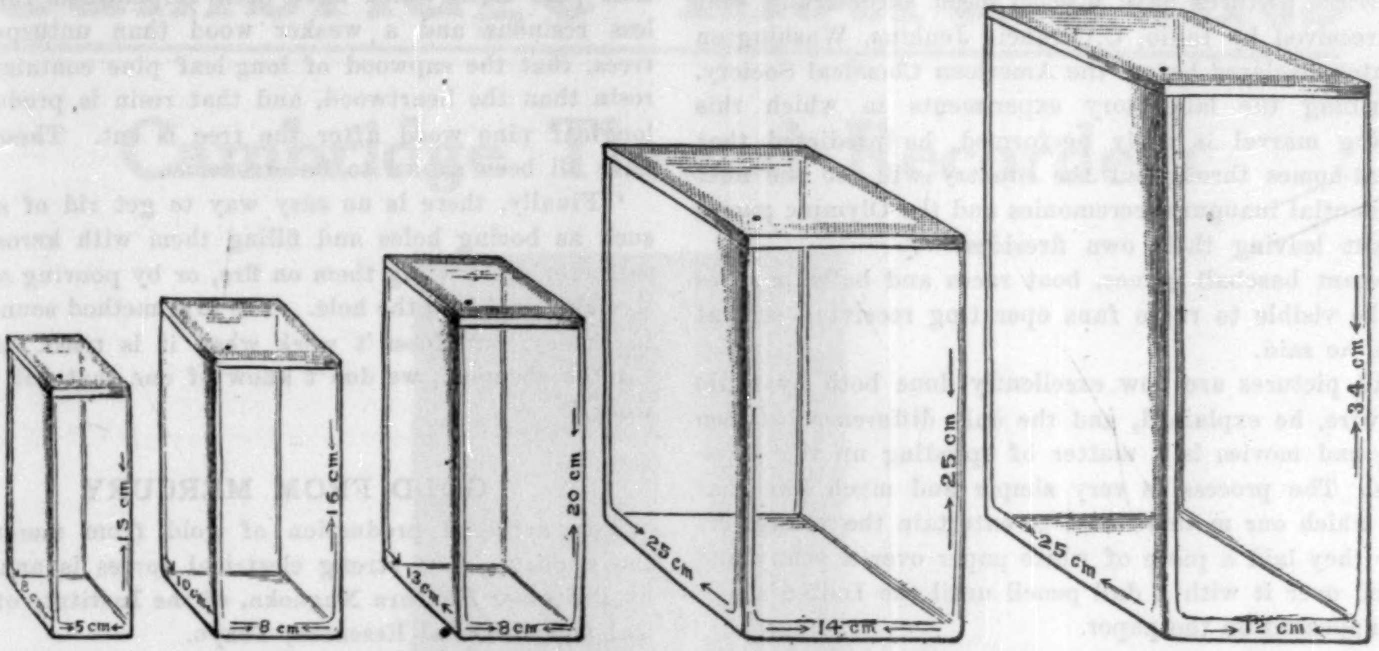

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Width, cm.	22	25	17.5	25	15	20	25	29	25	15	10.5
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RADIO MOVIES

Motion pictures have already been successfully sent and received by radio, C. Francis Jenkins, Washington inventor, declared before the American Chemical Society. Describing the laboratory experiments in which this seeming marvel is daily performed, he predicted that stay-at-homes throughout the country will see the next presidential inaugural ceremonies and the Olympic games without leaving their own firesides.

Distant baseball games, boat races and baby parades will be visible to radio fans operating receiving sets at home, he said.

Still pictures are now excellently done both by radio and wire, he explained, and the only difference between stills and movies is a matter of speeding up the apparatus. The process is very simple and much like that with which our mothers used to entertain the youngsters when they laid a piece of white paper over a penny and rubbed over it with a dull pencil until the Indian's picture appeared on the paper.

By means of turning glass disks with prismatic edges a tiny pencil or point of light is made to travel across a photographic plate in a succession of parallel adjacent lines. The picture is formed by constant changes in the strength of the light which is controlled by the varying strength of the incoming radio signals.

By speeding up the disks and other apparatus, the inventor declared he had succeeded in sending motion pictures from one room of his laboratory to another and the practicability of sending at great distances has been demonstrated.

FALLACIES ABOUT WOOD

"Seventeen fallacies about wood" were discussed by Dr. L. F. Hawley, of the U. S. Forest Service, before the American Chemical Society, who took occasion to deny a number of popularly accepted but erroneous ideas.

After disposing of what he characterized as the complimentary but untrue notion that a chemist can tell all about what a given kind of wood is good for, merely by analyzing it, Dr. Hawley took up a few of his "seventeen fallacies" in detail.

"It is not true," he stated, "that wood from trees cut in summer is much less resistent to decay than that cut in the winter. The apparent difference in durability is due to the conditions for decay being more favorable during the summer than during the winter, and not to any seasonal difference in the chemical composition of the wood.

"Neither is it true that blue-stained wood is weaker than similar unstained wood. The fungus that causes the stain feeds on the starches and sugars in the wood, and not on the wood itself.

"The idea that wood can be so modified by treatment that it no longer absorbs moisture and therefore no longer shrinks or swells is wrong. The attraction of wood for moisture is so great that there are very few coatings which are able to do more than retard the process of absorption.

"There are several erroneous ideas about pines that have been tapped for turpentine. Some people think that pine trees which have been turpentined furnish a less resinous and a weaker wood than unturpentined trees, that the sapwood of long-leaf pine contains more resin than the heartwood, and that resin is produced in longleaf pine wood after the tree is cut. These ideas have all been shown to be erroneous.

"Finally, there is no easy way to get rid of stumps, such as boring holes and filling them with kerosene or saltpeter and setting them on fire, or by pouring a corrosive chemical into the hole. The first method sounds well in theory, but doesn't work when it is tried. And as for the chemical, we don't know of one that will do the work."

GOLD FROM MERCURY

The artificial production of gold from mercury by the application of strong electrical forces is announced by Professor Hantara Nagaoka, of the Institute of Physical and Chemical Research, Tokyo.

Such a transmutation was recently reported by Professor A. Miethe, of Berlin, but the Japanese chemist used a different method. Miethe worked with an electric field as small as 170 volts per centimeter, but Nagaoka employed many million volts and by a special device concentrated it upon a narrow space in the immediate neighborhood of the surface of the mercury.

In a statement made to Science Service, Professor Nagaoka says:

"Although the yield is small, and can only be examined with a microscope of low magnifying power, mercury is transmuted into gold. After a few more experiments as to the best laboratory arrangement, the method will be made public. So far as the experiment goes, gold comes out in colloidal state and forms beautiful ruby glass. On evaporating the treated mercury, gold is deposited on the bottom of the vacuum distilling apparatus in a very thin film, which viewed with nearly normal reflected light shows the characteristic yellow color, and seen with transmitted light the complementary greenish tint. It stands the usual Cassius purple test for gold.

"It was only in an extremely intense electric field that the experiment succeeded. In order to be sure of transmutation, repeated purification of mercury by distilling in vacuum at temperatures below 200 degrees Centigrade is essential.

"Finally, I wish to state that there are many Tokyo papers and journals giving mistaken notions of the experiment, so that translations of different statements are not in the least to be trusted."

The object of these researches is not the production of gold in commercial quantities but the study of the internal structure of atoms. From an investigation of the fine structure of the lines of the mercury spectrum, published in No. 13 of the Scientific Papers of the Institute, Dr. Nagaoka came to the conclusion that the

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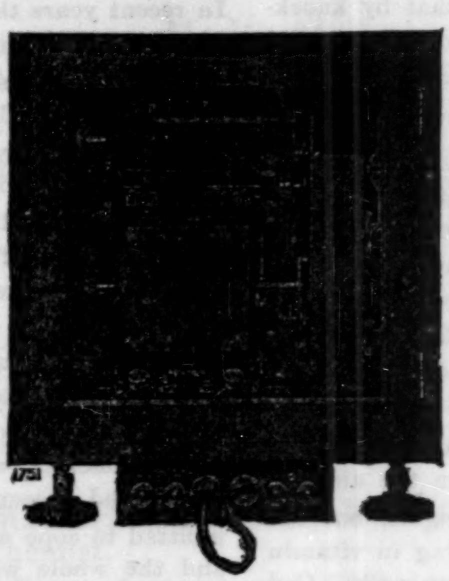

These instruments are designed to give a series of records of the instantaneous deflections of a galvanometer pointer. The method adopted has the advantages of avoiding all errors due to pen friction and of enabling charts with rectangular coordinates to be employed.

In this recorder, which is entirely clock driven, a silk thread, impregnated with ink, passes between the pointer and the chart, and once or twice every minute the pointer is automatically depressed so that it forces the thread down on the chart, making a small, sharp dot.

The charts are approximately 33 centimeters long and 10 centimeters wide, one complete revolution of the drum taking place in 25 hours, or by means of a simple change-speed gear, in 2 hours 5 minutes.

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nucleus of the mercury atom consisted of compact central mass with a proton particle elastically connected with it. If this proton could be detached from the mercury atom by some sufficiently powerful force the remaining nucleus would have the same positive charge as that of gold, and a similar arrangement of electrons. The spectroscope verified this surmise and the next step was to construct apparatus that would expel the proton from the mercury nucleus and thus effect the transmutation of the element into gold which he now reports accomplished. Since proton is the nucleus of a hydrogen atom the result may be roughly expressed by saying that by knocking out a hydrogen atom some of the mercury atoms are reduced to gold atoms.

VITAMIN X

VITAMIN X, the newly discovered vitamin whose presence in foods is necessary for the production of offspring, has been shown to be present in a large variety of vegetable and animal substances by Drs. Herbert M. Evans and George O. Burr, of the University of California, who told of their results before the American Association of Anatomists meeting at Cleveland on April 11.

They have found it to be present in small concentrations in many kinds of animal tissue, when the animals had been fed on vegetable foods containing it, but not in parts of animals fed upon a ration lacking in vitamin X. It is present also in milk fat and egg yolk. Cod liver oil, an important source of the vitamin that prevents rickets, is almost totally lacking in the fertility vitamin.

In vegetable tissues, the investigators state, vitamin X is low or absent in potato tubers, but abundant in leaves and is not injured by careful drying of such leaves as lettuce, alfalfa, pea and tea. It is present in some fruits, the banana for instance, and particularly abundant in seeds, such as those of wheat, corn, oats, cotton, lettuce and alfalfa.

"Since X is fat soluble, we have studied vegetable oils," the investigators state. "Most of them contain the vitamin, but few in high concentration; crude cottonseed oil, corn, olive, coconut, walnut, peanut and flaxseed oils can all be fed daily in quantities five times the required minimum of wheat germ oil without restoring fertility. Yet butter, walnut oil and a certain lard substitute have been proved to do this immediately when fed at high levels.

"The vitamin is thus seen to have a wide distribution if we disregard percentage abundance. In no other instances have we been able to encounter it in as concentrated form as in the ether extract of wheat embryo flakes and in desiccated leaves of lettuce."

THE CANADIAN WOOD BUFFALO

A PLEA for the maintenance of the racial integrity of the Canadian wood buffalo was presented before the meeting of the American Society of Mammalogists in session at Washington on April 8, by Dr. Francis Harper, of Cornell University. Dr. Harper is much opposed to the transfer of surplus animals from the Wainwright herd of plains buffalo to the range of the only surviving group of wood buffalo, now preserved in a special range in northern Alberta.

"The latter are practically the only representatives of the genus Bison left anywhere in a perfectly wild and unconfined state," said Dr. Harper. "They have been described as a distinct subspecies, being notably larger and darker than the plains buffalo. They are much better fitted than the latter to cope with two of the chief problems of existence in their own particular environment—deep winter snows and the depredations of timber wolves. In recent years they have been specially protected by the Canadian government, and have shown a gratifying increase in numbers. There is every reason to believe that this increase would continue naturally and steadily to the point where their range could support no more buffaloes.

"The Wainwright herd has lived for generations in enclosures, its vitality has been weakened, and it is said to be largely infected with tuberculosis. If placed together on the same range, the two races would inevitably interbreed. The mixture of the smaller, weakened and diseased plains buffaloes with the huge and vigorous wood buffaloes would be disastrous. In a few generations the wood buffalo, probably the noblest big-game animal of North America, would absolutely cease to exist as such. The mixed descendants of the two races might be quite unfitted to cope with the conditions of their environment, and the whole wood buffalo range might be eventually depopulated.

"Zoologists and conservationists in general have expressed the utmost concern over the critical situation thus confronting the wood buffalo," Dr. Harper concluded. "From every point of view, both biological and economic, the introduction of plains buffaloes into the range of the wood buffaloes is alike unnecessary and unjustifiable. Some other solution should be found for the difficult problem of disposing of the annual surplus of the Wainwright herd. It is essential that the wood buffalo stock should be kept pure and absolutely free from contamination with any other race of buffaloes."

ITEMS

Two stone axes which may prove to be among the earliest antiquities thus far found within the limits of the United States have been brought to the Smithsonian Institution by H. L. Straight, a brick manufacturer of Adel, Iowa. These ancient implements are crudely shaped and were discovered under 25 feet of apparently undisturbed clay, according to the information given to Neil M. Judd, archeologist of the U. S. National Museum, who is investigating the find. The digging of a trench for the laying of a narrow-gauge railway in the clay pits used by Mr. Straight led to the unearthing of the tools. On account of the possible importance of the discovery, the Smithsonian Institution is planning to send a geologist to make a carful study of the site to determine whether the axes are as antique as the depth of burial indicates. Mr. Judd pointed out that before the extreme antiquity of the axes could be determined, the report of the geologist showing geologic age of the strata in which they were buried must be received

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Note.—The new revision of Allen's Analysis is well under way. Volume I is enlarged over the former edition by 220 pages, which is an indication of the great extent of improvement made in recent years. Volume II is enlarged over the former edition by 286 pages. The editors have attracted prominent men in many lines of chemical industry to collaborate in the preparation of the new Allen. The complete work will comprise 9 volumes. Volumes I, II, and III are published. Volume IV is all in type and there is every indication that the other volumes will follow at short intervals.

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SCIENCE NEWS

Science Service, Washington, D. C.

GIANT NEBULAE

Two clouds of white hot gases each so vast as to be capable of engulfing not only the solar system, but many of the nearest stars as well, have been found in two different parts of the sky, according to an announcement by Professor Harlow Shapley, director of the Harvard College Observatory. One is in the Great Magellanic Cloud, a luminous area in the constellation of Dorado resembling a detached piece of the Milky Way. It can only be seen from points in the southern hemisphere, but the other one is in the constellation of the Triangle which is visible in our northern skies in the early winter. It is connected with a spiral nebula, Messier 33.

Both of these objects have been known for some time, although they are only visible with a large telescope and are known only by their numbers in the new general catalog of such objects. The southern one is referred to by astronomers as N. G. C. 2070 and the other as N. G. C. 604. Determinations of their actual size, however, have only been made possible by recent determinations of their distances.

Professor Shapley himself measured the distance of the Large Magellanic Cloud by a study of photographic plates made at the Harvard branch observatory at Arequipa, Peru, and found it so far away that its light would take a hundred thousand years to reach us. The distance of the spiral, Messier 33, was determined last year by Dr. Edwin Hubble, of the Mt. Wilson Observatory, and it turned out to be about a million light years.

Using these measures of the distances, it is found that the diameter of N. G. C. 2070 is 264 light years and for N. G. C. 604 it is 198 light years, so that if the earth were placed at the center of either one, not only would the sun and planets of the solar system be included in it, but so also would a large number of the stars we see in the sky. Both objects are much greater than the more familiar gaseous nebulae, such as the one in Orion, which is only about three light years in diameter, less than the distance from us to the nearest known star.

THE GROWTH OF BACTERIA IN POLARIZED LIGHT

Growth and activity of bacteria can be speeded up by the kind of light supplied by the moon, T. F. Morrison, graduate student at Princeton University, has discovered through experiments on the kind of microorganisms that cause dead fish to shine in the dark. This work follows up and appears to confirm results obtained a couple of years ago by E. G. Bryant, in South Africa, who found that fish exposed to the moonlight spoiled more quickly than those kept in the dark.

In his experiments Mr. Morrison used an artificial moonlight, made by passing ordinary electric light through a polarizing prism. The waves in polarized light vibrate in one direction only, instead of haphazardly at all angles as in ordinary light. Moonlight is known to consist very largely of polarized light; Mr. Morrison used "artificial moonlight" partly to avoid having to wait for a bright moon and then having to sit up all night, and partly because the artificial light could be subjected to laboratory controls.

He divided a culture of luminescent bacteria in three parts, one of which he placed under polarized light, or "artificial moonlight," one under ordinary light, and the third in darkness. In fifteen out of eighteen experiments he got results much more quickly under the polarized light.

Mr. Morrison does not yet offer to explain why polarized light should cause greater growth and activity than ordinary light or no light at all. His experiments, however, were inspired by the work of an English botanist, Miss E. S. Semmens, who found that the digestion of starch in plants is stimulated by either moonlight or artificial polarized light, and who has demonstrated that seeds germinate more rapidly under its influence. Mr. Morrison states that while there is no starch in bacteria, there are other chemical substances present that are related to starch, and that his results may be considered as parallel to those of Miss Semmens.

BROMINE FROM SEA WATER

Commercial methods of working the sea for treasure are being developed, and the tiny proportions of valuable materials in sea water may soon be a big item in the world's resources.

The expedition of the steamship *Ethyl*, which is to cruise in mid-ocean taking in millions of gallons of water and extracting 50 tons of bromine in a month, indicates that the vast ocean territory can be practically "mined." There are 86,800,000,000,000 tons of bromine in the ocean. The world's normal output of bromine has been less than 2,000 tons a year, of which America produces 900 tons. The American bromine has been produced chiefly from brine wells in Michigan and Ohio.

But American chemists have devised a method of extracting the pound of bromine hidden in 30 tons of sea water without the necessity of evaporating this huge amount of water. As a result the *S. S. Ethyl* has been made into a floating chemical factory and will be sent out to operate far from the shore away from sand and other floating impurities.

The United States' output of bromine has been considered at a maximum, but it has still been insufficient to meet the large demands resulting mainly from our own increasing consumption in the manufacture of tetraethyl lead, the fluid used as an anti-knock addition to gasoline. Prices of sodium and potassium bromides have more than doubled since January, 1924, due to the increasing need for bromine in medicine, photography, the moving pic-

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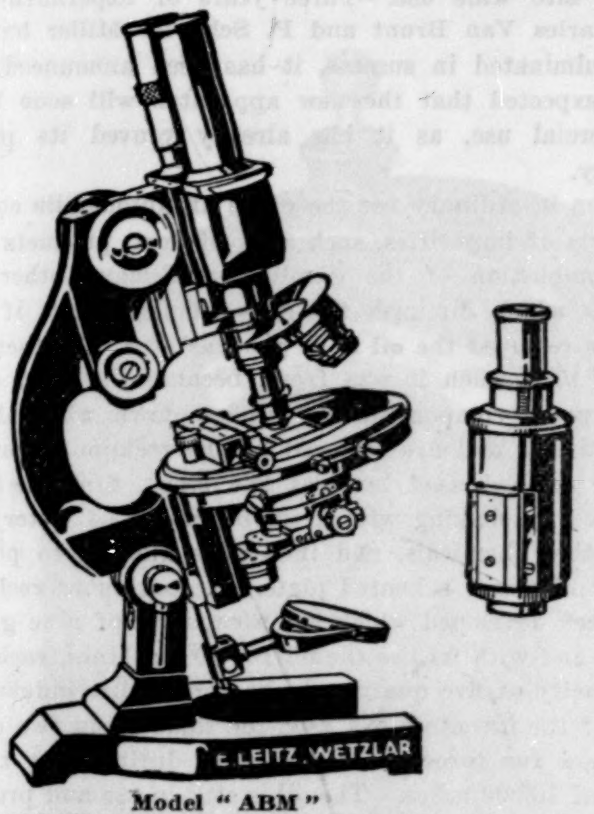

Model "ABM" with Binocular Body Tube attached.

DETAILS OF CONSTRUCTION AND FEATURES:

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2. **Binocular and Monocular Body Tubes can be very easily interchanged and attached by eccentrically acting lever clamp.**
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4. **When either Binocular or Monocular Tubes have been inserted into the tube carrier, the patented clamping device arrests these tubes automatically in a thorough true position to the optical center.**
5. **The Nosepiece Adapter is mounted independent of the tubes; objectives remain permanently centered; irrespective of which tube is used.**

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The Leitz Works through new constructions have frequently caused a revolution in microscope models and optics.

ture industry and in production of the ethyl fluid of motor fuel.

Although bromine is not present in the ethyl anti-knock solution as actually used in motor fuel, it plays an important part in its manufacture by entering into chemical combination with the ethyl portion of the compound. Most of the bromine is used over and over again, but the Ethyl Gasoline Corporation, in view of the shortage of the chemical, found it necessary to develop a new source of supply.

Of the 35 parts of solid matter contained in 1,000 parts of average sea water, about two tenths of one per cent. is magnesium bromide. The percentage of bromine itself in the water is only about seven thousandths of one per cent. Sea water contains 32 of the 92 known elements, all of which are supposed to have been washed into the ocean by fresh water streams that leach the soluble constituents from the soil.

The small quantities of gold in sea water have attracted chemists for many years and Professor Fritz Haber, famous German chemist, is the latest scientist to work seriously on a process for its extraction.

PITHECANTHROPUS ERECTUS

PROFESSOR HANS WEINERT, of Berlin-Potsdam, who has compared his own data with the measurements of the famous skull of *Pithecanthropus erectus* recently published by its discoverer, the Dutch physician Eugene Dubois, states that the revised data place this most ancient of man-like creatures in the long-headed class, popularly supposed to comprise only the aristocracy of races.

Although the skull-top, thighbone and bit of jaw, the only relics so far discovered of Pithecanthropus, were found over thirty years ago, Dr. Dubois has until within the last few days given out only preliminary results of his studies, and has permitted very few scientists to see his specimens. Dr. Weinert, however, has been one of the few privileged to study them, and has made careful measurements. The new figures show that the width of the skull is less than three fourths of its length, which places it in the "long" classification.

Dr. Weinert also reviews the controversy as to whether Pithecanthropus was really a man or simply a large ape. He inclines to the opinion that the creature was truly human, though on a low level. The three loose teeth that have been found, and the roots of the teeth in the jaw fragment, are all of a human rather than an ape type, though rather large for a man.

More important, however, is the size of the brain. The portion of the skull in Dr. Dubois's hands has a capacity of 570 cubic centimeters. This is estimated to be about two thirds of the capacity of the original brain cavity, which would thus be approximately 900 cubic centimeters. This is nearly double the size of the gorilla's brain, which is 500 cubic centimeters, but nowhere near the size of a modern man's, which runs from 1,200 to 1,600. Only the smallest brains among the pygmy races are as small as 900 cubic centimeters, and Pithecanthropus, though not so tall as a modern man, was no pygmy. Sir Arthur Keith, the British anthropologist, sets 1,000 cubic centimeters as the lowermost brain size that can be called human. With an estimated 900 and a little scientific charity, Pithecanthropus just makes the grade. And still he is a long-head.

DEVICE TO RECLAIM MOTOR OIL

No longer will motorists need to discard the oil from their crankcases and buy a fresh supply regularly if a new apparatus for reclaiming it developed at the Research Laboratory of the General Electric Company comes into wide use. Three years of experimentation by Charles Van Brunt and P. Schuyler Miller have at last culminated in success, it has been announced, and it is expected that the new apparatus will soon be in commercial use, as it has already proved its practicability.

When in ordinary use the oil in an automobile collects all sorts of impurities, such as road dust, products from the combustion of the gasoline, and many other substances which diminish the oil's efficiency, but if they can be removed the oil is as good as ever. In fact it is better than when it was fresh, because the most easily decomposed components are broken down when the oil is first used and are removed by the reclaiming process.

The method used involves two steps, first the oil is clarified by shaking with a small amount of water glass and other chemicals, and then it is allowed to pass in a thin film over a heated plate. A continuous reclaimer has been developed which has a capacity of nine gallons a day and with its use the oil for 30 machines, each with a capacity of five quarts, can be kept in use indefinitely. One of the inventors has used the same oil in two different cars for three years, traveling during that time a total of 16,000 miles. The oil is still in use and promises to remain so indefinitely.

Several other investigators have reported success in reclaiming old automobile oil by other processes within the past few months and commercial utilization of these advances in chemistry is predicted.

THE POPULATION OF THE UNITED STATES

ALTHOUGH the population of the United States is now at the high water mark of 114,311,000 people, the advance over last year was less than the average for the last five years, according to the estimates of the National Bureau of Economic Research, and the opinion is that the once rapid advance has now definitely slowed up.

That the regular increase in the population has not been due to immigration but to the excess of births over deaths is shown by figures covering the last sixteen years. In that period there were over 41 million births and about 22 million deaths, or an excess of 19 million births. About 5½ million were added by immigration, bringing the total increase to about 24 million. Of this number, immigrants formed little more than a fifth.

Both the birth and the death rates in the United States are falling, but the death rate is falling faster. Ten years ago the birth rate was 26.2 for each thousand per-

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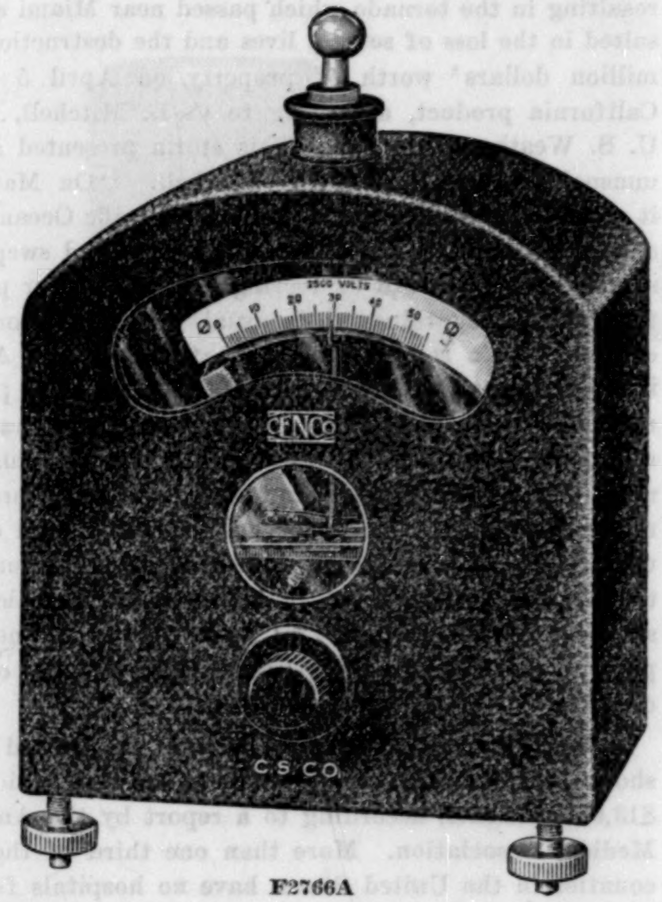

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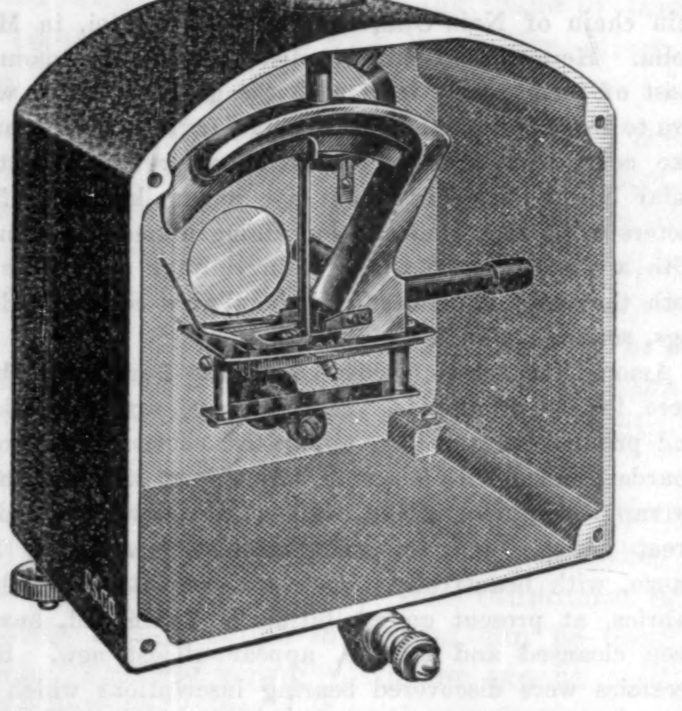

Interior View Showing Details

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sons while to-day it is 23.3, a decrease of 11 per cent. At the same time the death rate has decreased from 13.4 per thousand to 11.7, a decrease of about 13 per cent.

In 1924, 2,645,000 babies were born and 1,333,000 persons died, or one death was compensated by two births. If the number of births and deaths remains stationary in 1925, as is very likely, ten babies will be born every two minutes and 5 persons will die in the same time.

Further studies by the bureau showed that employment has again shrunk to the pre-war level, and that there are now 38 persons out of every 100 who earn a salary or wages. But children, women and others not working for money are almost as numerous as this class. Employers and men and women in business for themselves make up only 8½ per cent. of the population, and the actual number is now less than it was in 1915. It is held that the growth of large corporations has kept down the number of independent business men.

EXCAVATIONS IN MONGOLIA

The Russian archeologist and explorer, P. K. Kozlov, head of the Russian Geographical Society's expedition to Tibet, has recently returned to Leningrad with an extensive collection of treasures of an ancient civilization. Many of these relics date from the second century, B. C., and bear traces of Indian, Byzantine and Greek influence.

The chief excavations were carried out in the mountain chain of Noin-Ulla, southwest of Kentei, in Mongolia. Here the expedition discovered burial mounds, most of them nearly level with the ground; a few were two to three meters high in rectangular form with funnel-like central depressions. Excavations revealed rectangular burial chambers, about five meters long and four meters wide, each chamber containing a smaller chamber with a wooden coffin. The wall, ceilings and floors of both the inner and outer chambers were constructed of logs, squared, planed and joined.

Among the relics discovered in the burial chambers were bronze ornaments, vases, glasses, wooden articles and primitive fire-making apparatus, consisting of small boards pierced with holes in which heat was generated by rapidly rotating sticks. Silken fabrics were found of great artistic and scientific interest, resembling fine gauze, with beautifully woven designs. Some of these fabrics, at present on exhibition in Leningrad, having been cleansed and treated, appear almost new. Rich ceramics were discovered bearing inscriptions which revealed the epoch to which they belonged—the Hang dynasty, dating at least 200 years B. C. The gem of the discoveries is considered to be a tapestry, representing an elk attacked by a winged griffin, and showing Greek influence.

Gold ornaments indicated Indian, Persian and possibly Greek influence. They include a ring, bearing the head of a mythological animal with a stone set in the forehead, and a horse resembling those depicted on Scythian vases.

The excellent preservation of these relics is attributed to the fact that the tumuli were from thirty-five to fifty feet deep, at which depth the temperature was practically constant at the freezing point, and had not changed for centuries.

The expedition also brought back important botanical and zoological collections which have been distributed among the appropriate museums.

Study of these relics reveals that two thousand years ago there flourished in the plains of Mongolia a people whose art bears traces of their contact with Hellenic culture. The excavations were carried on in the Sudzuk Valley, about 120 versts from Urga, and only fifteen miles from the great caravan route.

ITEMS

The traditional jealousy between California and Florida evidently has even affected the weather, for the storm resulting in the tornado which passed near Miami and resulted in the loss of several lives and the destruction of a million dollars' worth of property on April 5 was a California product, according to C. L. Mitchell, of the U. S. Weather Bureau. "This storm presented several unusual features," said Mr. Mitchell. "On March 30 it entered the United States from the Pacific Ocean about a hundred miles north of San Francisco, and swept east southeast, but instead of veering northeast after passing the Rocky Mountains, as is usual with such storms, it continued in a straight line and at 8 A. M. on April 4 it covered northern Mississippi. Still in the same path, it reached Florida on April 5. Up to this time it had been relatively mild, and had not done any damage, but when near Miami, it developed into the tornado which produced the destruction." That southern Florida is well off the usual track of tornadoes is indicated by the records for the last eight years, in which 752 occurred, of which only six were in Florida. Most of these were in the northern part of the state, and they resulted in the loss of only one life.

A recent count of hospital beds in the United States shows that the 7,370 hospitals have accommodations for 813,926 patients, according to a report by the American Medical Association. More than one third of the 3,068 counties in the United States have no hospitals for general service within their borders. A comparatively small percentage of practising doctors are affiliated with hospitals: in New York, 36 per cent., in Cleveland 29, and in Chicago and its suburbs 25. Many hospitals in this country use the services only of staff physicians, but the association reports that the present tendency in medicine is to urge hospitals to adopt a more open policy in permitting physicians who are not on the staffs to treat hospital patients.

Just as cities have their hustling daytime populations and their night-life denizens made up of quite separate classes of people, so the little Saharas on American sand dunes have entirely different day and night populations of insects, Professor Royal N. Chapman, of the University of Minnesota, and some of his graduate students have discovered through a study of small dunes here in Minnesota. They found a night population consisting almost entirely of one species of beetle, which burrowed deeply into the ground at the first streaks of day, and remained there until dark came again. The daytime population was more varied. Both night and day groups were largely governed in their movements by temperature.

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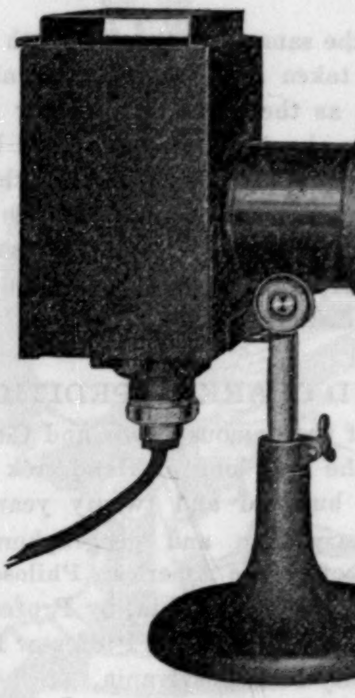

TEACHERS of Anatomy, Zoology and Embryology will appreciate the value of this new combined Drawing and Projection Microscope.

The mirror over the front of the lens of the projector is provided with a hinged mount. When this mirror is tilted down at an angle of 45° (as shown in the illustration) the light is directed downward and the image formed on the paper or plane surface for drawing. When the mirror is in a horizontal position, the image is projected upon a vertical screen—the equipment thus serving as a low power projector. Both the illuminating unit and the projection microscope can be used separately. In fact they can be purchased separately. The illuminant is in reality a microscope lamp and can be used as such. The low power projector can be used equally well when attached to the projection lens of any Balopticon or other suitable light source.

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SCIENCE NEWS

Science Service, Washington, D. C.

MOUNTAIN CHAIN FORMATION

A THEORY of mountain-chain formation based on the slow sliding of whole continental blocks over a substratum of volcanic glass was proposed at the American Philosophical Society in session in Philadelphia, by Dr. Reginald A. Daly, of Harvard University.

According to Dr. Daly's theory, great sections of the earth's crust, slowly heaved and tilted out of a stable position, gradually migrate in the direction of their slope. This slope may be very slight, and migration very slow, even a few inches a century, yet it goes on for such long periods that great changes, even the formation of huge mountain ranges, may take place.

Such a "downstream" migration of a continental block, Dr. Daly said, could not be imagined over a fixed and rigid base; but "for good reasons we may assume the earth's crust to be underlain by a universal substratum of basaltic glass at a temperature of 1,200 to 1,600 degrees Centigrade, or 2,200 to 2,900 Fahrenheit. The rigidity or stiffness of the substratum is great because of the hydrostatic pressure upon it; yet, as in the case of pitch, the resistance to flow breaks down with the passage of time, if a permanent, one-sided pressure or stress be applied to the substratum material."

Two things happen to a migrating continent, Dr. Daly continued. The edge of the "downstream" side, upon reaching the limit of its migration and encountering resistance, wrinkles and crumples into mountain folds, like the outer edge of flowing tar or molasses. On the "upstream" side the crust is stretched and finally cracked, allowing the interior magma to come to the surface as great non-volcanic lava flows.

SPIRAL NEBULAE

MANY of the spiral nebulae and the irregular nebulae in parts of the sky outside the Milky Way, which have long defied the efforts of astronomers to see them as other than continuous areas of light, have surrendered to the largest telescope in the world, the great 100-inch reflector at the Mt. Wilson Observatory in California, Dr. Edwin Hubble told members of the American Philosophical Society at the recent Philadelphia meeting. Photographs made of these objects by Dr. Hubble have revealed the stars of which they consist and demonstrate that the reason these stars have not been seen before has been because of lack of sufficiently powerful instruments, just as the Milky Way itself, consisting of millions of stars, appears continuous to the unaided eye. The irregular nebulae are now shown to be objects like the Magellanic Clouds, seen in the southern hemisphere and resembling the Milky Way, but so distant that the largest instruments hitherto in use have not been able to resolve them.

Dr. Harlow Shapley, director of the Harvard College Observatory, who recently announced the discovery that two gaseous nebulae, one in the large Magellanic Cloud and the other in the spiral nebulae Messier 33, are each so large that a beam of light would take two centuries to pass from one side to the other in either, has continued his comparisons of the cloud and the spiral. Determination of the distance of the spiral has made possible a measurement of its diameter which turns out to be about 15,000 light years, while that of the cloud is about 14,000 light years.

Besides being about the same size, they are both of the same brightness, each, taken as a whole, being about a million times as bright as the sun. The smaller groups of stars within each are about the same size and brightness, so that Professor Shapley concludes that they are of similar nature. The importance of this idea, he points out, is that the Magellanic Clouds are much closer than the spirals and hence they can be studied to gain information concerning the distant spirals.

THE LEWIS AND CLARK EXPEDITION

THAT the members of the famous Lewis and Clark expedition, which made the first long overland trek to the Pacific Northwest one hundred and twenty years ago, were more than military men and geographers, was demonstrated recently before the American Philosophical Society's annual session at Philadelphia, by Professor R. DeC. Ward, of Harvard University, and Professor Rodney H. True, of the University of Pennsylvania.

Professor Ward told of the field work in meteorology done by Captain Lewis, whose remark "I have observed that the thunder clouds in the western part of the continent proceed from the westerly quarter as they do in the Atlantic States" is probably the first specific mention of this important weather fact. Captain Lewis also noted the more rapid evaporation on the western plains; he observed the rate at which his ink dried on the paper as a gauge of the climatic dryness.

That botany as well as weather was studied on this famous expedition was commented on by Professor True, who has studied some unpublished correspondence between President Jefferson and Bernard McMahon, of Philadelphia, who cultivated plants and seeds brought back from the West by Captain Lewis. Among the native plants thus brought into cultivation were the Osage orange, well known as a hedge plant; the ornamental shrub snowberry, several varieties of currants that have since taken an established place among cultivated ornamental shrubs, as well as a number of herbaceous plants. Notable among the latter were two genera, then newly discovered and named in honor of the leaders of the expedition. Lewisia, the bitter-root, is now the state flower of Montana, and Clarkia, a member of the evening primrose family, is a fine ornamental flower.

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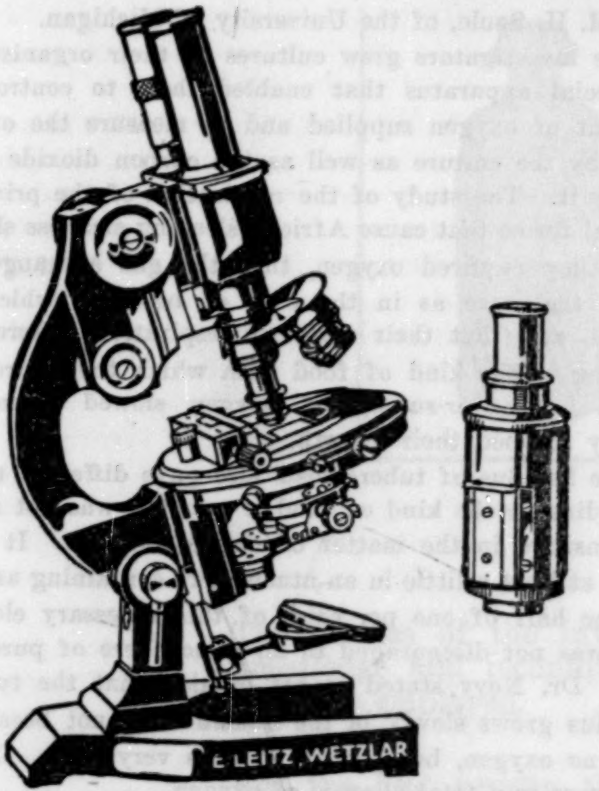

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TROPICAL CLIMATES

SEASONAL, or even daily, changes of residence were suggested as a means of lessening the insidious influence of tropical climate on the white man, by Dr. Bowman C. Crowell, professor of pathology at Jefferson Medical College, at the meeting of the American Philosophical Society.

Climate and disease, the two factors that have prevented the white race from establishing itself in the tropics, can be successfully combated. The productiveness of the warm countries is so great that it might be economically feasible to provide for the cooling of houses and in other ways to make it possible for the white man to be comfortable and healthy in the tropical environment.

"There is difference of opinion as to the effect of tropical climate," said Dr. Crowell. "Science has not been able to measure the unquestionably harmful influence on the nervous system of a constant temperature, bright sunshine, brilliant colors and the absence of seasonal variations. The equilibrium of the white man's nervous system and his energy and initiative are further disturbed by contact with impassive and at times stupid colored natives, by their untrustworthiness, and by the tendency to the abuse of stimulants and by the general lowering of the moral tone. Scientific investigation has not shown, however, that climate is any insuperable barrier to the white man's successful continued life in the tropics, and further serious investigation of the subject is imperative.

The method of control and prevention of most of the important transmissable diseases, such as cholera, plague, malaria, typhus, yellow fever and African sleeping sickness, are partially or fully known, he pointed out, and practical application of this knowledge is now largely a question of sufficient incentive.

PURE ALUMINUM

PURE aluminum, the goal of many years of research, will now be available in commercial quantities through the development of a new refining process described by Dr. Francis C. Frary, speaking before the American Electro-Chemical Society at Niagara Falls. The term "pure aluminum" is, of course, still a relative one, but its use is certainly now justified because the new "Hoopes" refining process makes this metal with less than two one-hundredths of one per cent. of impurity, even on a full commercial scale.

Previously the highest purity aluminum ordinarily available contained 99.7 per cent. of this metal. Some of the new product is as pure as 99.983. The principal impurity is copper, but traces of iron and silicon are also present. To make this exceedingly pure metal a special refining process using melted salts of sodium, aluminum and barium fluoride is used. The impure molten aluminum is carried by the electric current upward through the molten layer of these salts and is separated on top in a molten form from which point it can be poured or ladled off into molds.

This pure aluminum has a beautiful silver color and luster which it retains very well. The bluish tinge characteristic of commercial aluminum as found in the ordinary kitchen is eliminated because of the low content of iron and silicon. The first of these impurities causes a grayish color and the second a purplish color; and either causes the metal to become dull and lusterless on comparatively short exposure.

OXYGEN AND THE GROWTH OF BACTERIA

THE breaths of bacteria and other microscopic organisms were the subject of a discussion before the meeting of the National Academy of Sciences by Drs. F. G. Novy and M. H. Soule, of the University of Michigan.

The investigators grew cultures of their organisms in a special apparatus that enabled them to control the amount of oxygen supplied and to measure the oxygen used by the culture as well as the carbon dioxide given off by it. The study of the respiration of the primitive animal forms that cause African sleeping sickness showed that they required oxygen, that the gas exchange was much the same as in the case of bacteria, which are plants, and that their rates of respiration differed according to the kind of food with which they were supplied. An over-supply of oxygen slowed down and finally stopped their growth.

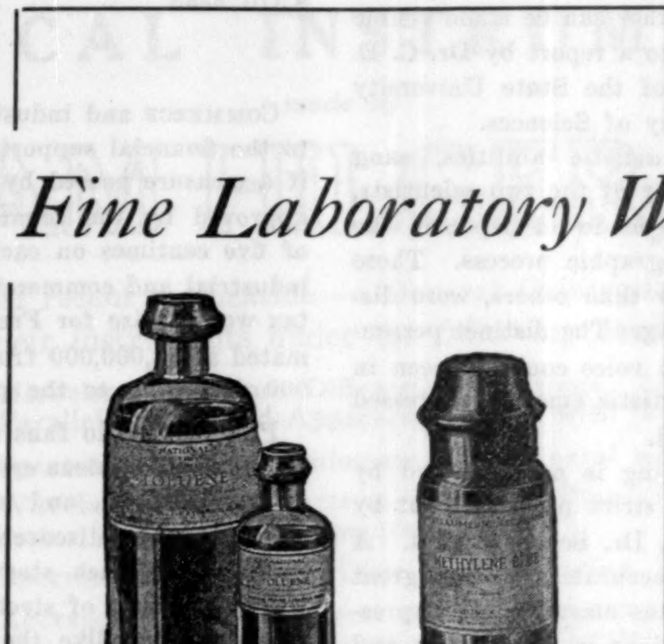
The bacillus of tuberculosis also gave different results according to the kind of food it got, but was not nearly so sensitive in the matter of oxygen supply. It could grow at least a little in an atmosphere containing as little as one half of one per cent. of this necessary element, and was not discouraged in an atmosphere of pure oxygen. Dr. Novy stated as his opinion that the tubercle bacillus grows slowly in the human body not because it gets no oxygen, but because it gets very little. It can not grow in a total absence of oxygen.

THE POLLUTION OF WELLS

THE belief that bacteria from outhouses can be carried only a few feet under ground has been proved a delusion as a result of recent extensive experiments. Bacteria from excreta deposits may find their way into the water of a well more than 200 feet distant, thus endangering the health of all who use that water supply, according to Professor C. W. Stiles, of the U. S. Public Health Service, who described the experiments at the meeting of the National Academy of Sciences.

The weather and the direction in which the ground water flows both influence the fate of bacteria left in the ground. Pollution extends only in the direction of the ground water flow. Rainfall causes the ground water level to rise. It picks up the bacteria, which are near the surface, and carries them further, spreading pollution. In dry weather, the water level falls, and the bacteria tend to filter out into the soil.

If dry weather continues sufficiently long, the bacteria die. Under favorable conditions, however, they may live under ground up to two years and eight months, and chemical pollution put in the ground for experimental purposes almost three years ago is still being recovered from wells at varying distances.



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ARTISTRY IN "ANNIE LAURIE" MEASURED BY SCIENCE

THE elusive quality that makes a piece of music "art" when sung by one soloist, and "just a song" when ordinarily well sung by another can be made visible and can be measured, according to a report by Dr. C. E. Seashore and Milton Metfessel, of the State University of Iowa, to the National Academy of Sciences.

Twelve singers, of varying artistic abilities, sang "Annie Laurie" in the laboratory of the two scientists, and records of their voices were made on paper in the form of wavy marks by a photographic process. These wavy charts, some more irregular than others, were displayed before the academy meeting. The distinct personality of the sound waves of each voice could be seen in the record, and the amount of artistic emotion expressed by each singer could be measured.

The emotional quality in singing is not obtained by following the written score with strict precision, but by minute deviation from the notes, Dr. Seashore says. A mediocre singer may sing more accurately than a great opera star, but the famous star has mastered the expression of emotion by subtle variations in pitch, time and intensity. And, as everything that the singer conveys to the listener is conveyed by means of the sound waves, a study of the sound waves shows every detail of the singer's technic and artistry.

The photographic method of recording music is advocated for scientific purposes because it produces a permanent record with minute detail.

THE BISON IN CANADA

CANADIAN successes in the effort to preserve from final extinction the last herds of American bison were reported before the mammalogists, by R. M. Anderson, chief of the division of biology of the Victoria Memorial Museum at Ottawa, Canada. Beginning with the low-ebb year of 1889, when it was estimated that in the United States and Canada there were only about a thousand survivors of the once vast herds of bison, Mr. Anderson sketched the share of the Canadian government in the work of rescuing the species.

The Canadian government received as a nucleus three animals from Texas in 1897, thirteen from the Lord Strathcona herd in Manitoba in 1898, and two from the Corbin herd in New Hampshire in 1902, all being sent to Banff. In 1907 the government purchased the entire Pablo herd in the Flathead reservation in Montana, 702 head in all, 410 of which were placed in Elk Island Park and the balance in the Buffalo Park at Wainwright. In 1909, 325 head were transferred from Elk Island Park and 77 head from Banff to Buffalo Park, and in 1910 30 head were purchased from the Conrad Estate of Kalispell, Montana.

The Buffalo Park comprises a fenced area of 160 square miles at Wainwright in which the buffalo have increased rapidly under protection. In 1913 there were 1,188 head and in 1915 over 2,000. In 1922 they were taxing the resources of the park and a number were killed. The herd was further thinned in 1923 and about 2,000 animals were killed and the meat and hides sold on the market. At the present time—1925—the Canadian government has about 8,000 buffalo at Wainwright, 348 at Elk Island Park and 22 at Banff, a total of about 8,370 head.

ITEMS

COMMERCE and industry will be required to contribute to the financial support of scientific research in France, if a measure passed by the Chamber of Deputies is also approved by the senate. The bill provides for a tax of five centimes on each 100 francs paid in salaries by industrial and commercial concerns. The sum which the tax would raise for French scientific laboratories is estimated at 14,000,000 francs a year. This is about $700,000 according to the present rate of exchange.

PARISIAN radio fans are hopeful that a new substance to replace the galena crystal will prove to be the dreamed-of super-crystal, and not just another substitute. The substance was discovered by chance by Felix Thuaud, prominent French steel manufacturer. While studying the by-products of steel, Thuaud noticed a material that was somewhat like the crystal used in radio sets. He chipped off a few pieces and had radio fans try them. Their report was that concerts were heard over longer distances and with greater clearness than with galena points. Thuaud also found that it was not necessary to hunt for special points of contact, as the new material was adequately sensitive at any point. The basis of the material is a combination of silicon and iron, with the former dominant. The product can be made in an electrical furnace or in an ordinary crucible. It can be sold at about one fourth the price of substances now used.

A NEW thermometer, which measures accurately temperatures as low as 380 degrees below zero, Fahrenheit, was described to members of the American Philosophical Society by Dr. W. A. Noyes, professor of chemistry at the University of Illinois. As mercury freezes at such a low temperature a bulb connected with a very narrow tube containing air is used. As the air expands and contracts with variations in temperature a small globule of mercury, kept at a temperature above its melting point, moves back and forth, thus serving as an index.

TEN thousand children every year die from tuberculosis and very many more are irreparably injured owing to infection from tuberculous cattle. This statement was made by Dr. M. J. Rowlands, late senior pathologist at University College Hospital, London, in an address to the People's League of Health, but it was accompanied by the reassuring assertion that it was the speaker's conviction that tuberculosis could easily be eliminated from cattle if they are suitably fed. "It is quite unnatural," he said, "to drain off from cows the vast quantities of milk that are now taken, and the effect is to remove from the cows the vitamines essential to health. It must be remembered that vitamines are only present in natural foods for a few months in the year," the speaker said. His own experience as a breeder has been that if vitamine-containing foods are given to cattle the herds could be maintained entirely or nearly free from tuberculosis.

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SCIENCE NEWS

WIRE STORIES ON THE MEETING OF THE NATIONAL ACADEMY OF SCIENCES

By Edwin E. Slosson, Director of Science Service

THE controversy over the Einstein theory of relativity was the most exciting event of the National Academy of Sciences in session at Washington on April 27 and 28. Three speakers argued in its favor and two against it. The sympathy of the audience was with the negative. Professor Dayton C. Miller, of the Case School of Applied Science, Cleveland, has repeated on Mount Wilson, Pasadena, the historic experiment on ether drift made by Michelson and Morley in the basement of that school in 1887. They got no evidence of relative motion between the ether and the motion of the earth in its orbit although they did not prove it absolutely zero. It is upon this negative result that Einstein, in 1905, founded his revolutionary theory of relativity.

But now Miller gets a positive displacement of the lines in the interferometer varying with the direction the instrument points and with the time of day and year, agreeing with the three known motions of the earth in space, its daily rotation, its annual revolution around the sun and its secular movement with the sun. The general result of his five thousand observations gives a motion of the earth relative to the ether of six miles a second, or about one third of the orbital velocity of the earth. This would indicate that the ether was partially dragged along with the earth, less on the mountain top than underground.

An unexpected contribution to the controversy was the telegram from Dr. W. S. Adams, of the Mount Wilson Observatory, read by Dr. George E. Hale, honorary director. This gave the first definite evidence for the Einstein theory from spectroscopic observations on stars.

Last year A. S. Eddington, of Cambridge, advanced the startling theory that the stars behaved like perfect gases even when they were denser than lead. This is because at such tremendously high temperatures in interior of stars the atoms are broken up into fragments of positive and negative electrons which can pack closer than the entire atoms. The heaviest element on earth is the metal osmium which has a density of about twenty-two times that of water. But one of the stars, the invisible companion of the familiar Dog Star, Sirius, though too small to be seen, is yet so heavy that its density figures out fifty thousand times that of water. Now Einstein predicted that light coming from a heavy star would be so retarded by gravitation that their wave length would be increased. This would shift the spectral lines toward the red end. Last year St. John, of Mount Wilson, verified this in regard to sunlight and now Adams finds the same effect in a star. The displacement observed agrees with that calculated from the theories of Einstein and Eddington.

A new test of the Einstein theory has been made by Professor A. A. Michelson, of the University of Chicago, and reported to the academy by Professor A. H. Compton. This experiment consisted in racing two rays of light in opposite directions around a rectangle of water pipe over a mile long from which the air had been exhausted. If the two rays had matched exactly on returning to their starting point it would have disproved Einstein, but the displacement observed, a quarter of a wave length, is that required by his theory.

Evidence against the prevailing theory that light consists of waves in the ether was presented by Professor A. H. Compton, who has been studying how X-rays break up the atoms and send the fragments flying. His experiments point towards the necessity of reviving in some form the older corpuscular theory of light.

Professor Heber D. Curtis, of the Allegheny Observatory, declared himself unconvinced of the Einstein theory, even though that might lay him liable to be called a "Fundamentalist in science." He thought that the measurements of star shifts obtained by President W. W. Campbell, of the University of California, on the Lick Eclipse Expedition to Australia in 1923 were too scattered to prove the displacement of stellar images predicted by Einstein, although Dr. Campbell considered them conclusive proof.

"The mode of the origin of species in mammals has now been completely determined by paleontology. So far from being a mystery little more needs to be done." This is the statement made by Dr. Henry Fairfield Osborn, director of the American Museum of Natural History, New York, to Science Service. His paper on "The origin of species as revealed by vertebrate paleontology; A rejoinder to William Bateson," was read at the recent meeting of the National Academy of Sciences, and gives the evidence on which this statement is based. At the Toronto meeting of the British Association for the Advancement of Science in 1921, Professor William Bateson, the founder of the British Genetic School, made the statement that "The origin of species remains utterly mysterious," and this ever since has been quoted in controversy as an authoritative denial of evolution, notwithstanding that Bateson took pains at the time to affirm his faith in evolution as a general principle. Now, however, Professor Osborn accepts the challenge of his old antagonist and lays down nine principles that have been developed or confirmed through his thirty-six years of paleontological research. Beginning with his study of the primates, the division to which man belongs, he followed it in an intensive study of the extinct group of titanotheres, an extinct family remotely related to both horses and rhinoceroses. The results of his sixteen years of study of that group is to be published by the U. S. Geological Survey. His more recent work on the elephant, horse and rhinoceros families has confirmed his theories of the origin of species. By the application of his principles it is possible to predict when and where an animal of a new species or genus may appear and what form it will take. So when Professor Osborn

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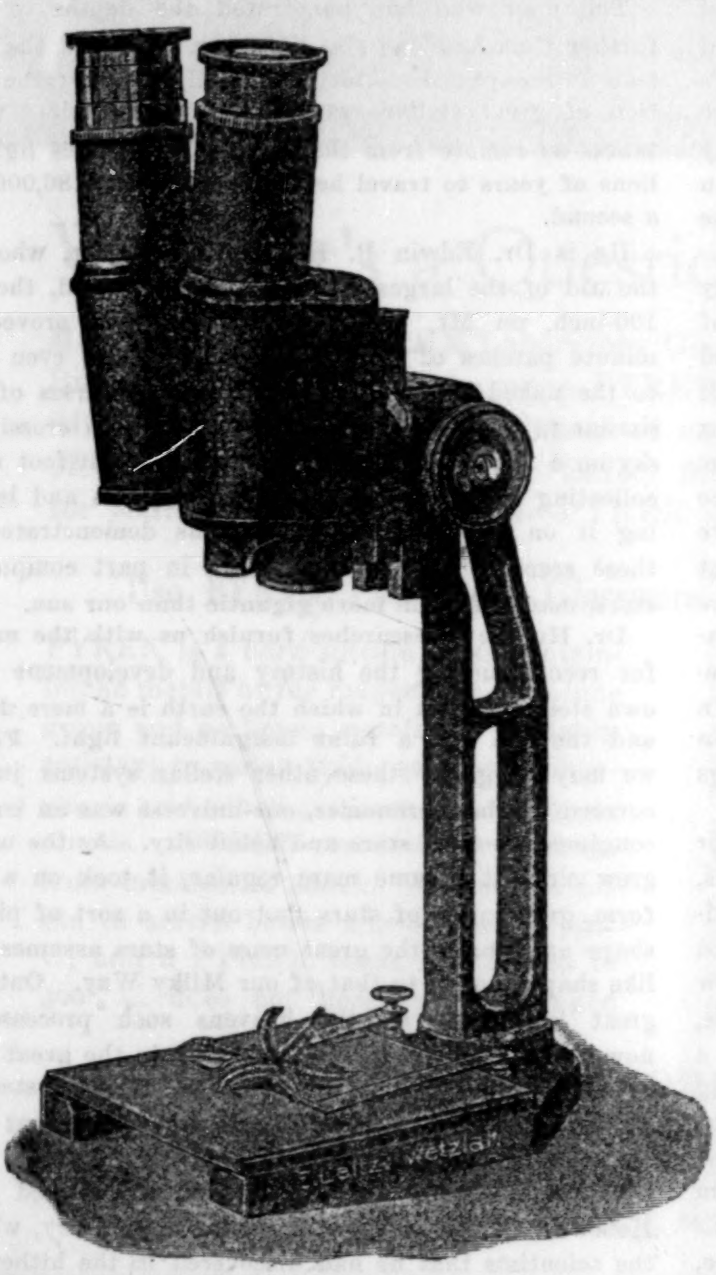

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picks up fossils of unknown mammals in Mongolia, he is able to compare them directly with fossils found in France or the Rocky Mountains as to stage, rate and direction of their development. His results directly contradict the theories of the vitalities, for they demonstrate that all mechanical characteristics represent adaptive reaction to long continued experience.

Continuity is the fundamental principle of his theory of evolution in opposition to the discontinuous theories recently in vogue. He would retain Darwin's principle of natural selection, but reject the idea that useful characteristics were developed from minute accidental variations in all directions. This is replaced in Osborn's theory by the "Principle of rectigradation of adaptive organs," according to which variations originate directly in the germ-plasm and develop in long ages in an adaptive direction until they finally obtain survival value in the struggle for existence.

A possibility of escape from the iron bonds of heredity was suggested by Dr. Oscar Riddle, of the department of genetics of the Carnegie Institution. He has proved that even sex can be completely reversed in adult pigeons and frogs by special conditions, although sex has been supposed to be determined at the start by the way the chromosomes unite in the germ cells. Since other physiological and psychological characteristics are transmitted the chromosomes "we may in the far distant future be able to choose which of the two factors we may permit to develop." Dr. Riddle has found by experiments on pigeons that when the thyroid gland becomes more active the body processes are speeded up. In autumn and winter the thyroid glands are larger than in spring and summer, and when they are larger the eggs laid produce a higher proportion of males.

That complete sterility may be caused by improper diet has been demonstrated by Professor H. M. Evans, of the University of California. He has found the antisterility Vitamin E most abundant in wheat germ and has been able to extract it in the form of a thick yellow oil of remarkable potency. A minute drop of this, weighing only a third of a milligram, given daily to a male rat, fed on a diet devoid of Vitamin E, will keep him normal throughout life and a slightly larger amount will enable a female rat to produce and rear litters of young. A larger amount than the essential minimum has no effect. Vitamin E is not destroyed by drying or cooking and is active in the dried leaves of lettuce, alfalfa, peas and tea.

WIRE STORIES ON THE MEETING OF THE AMERICAN PHILOSOPHICAL SOCIETY

By Watson Davis, Managing Editor of Science Service

Man and all living material is mere jelly, elastic as rubber, fibrous and thirsty for water. This is the character of protoplasm, the stuff of life, whose properties have been discovered through actual dissection of microscopic living cells performed by Dr. William Seifriz, National Research Council Fellow, at the University of Pennsylvania. He told the American Philosophical Society at its opening meeting at Philadelphia on April 23 that this fundamental stuff of all life most closely resembles gelatine, rubber, soap and casein. Dr. Seifriz explained how he had discovered that protoplasm is just as springy as a rubber band. Under a powerful microscope a minute particle of nickel only 1/2500th of an inch across was inserted into the heart of a living cell. Attracted by an electro-magnet the metallic particle stretched the protoplasm and when the magnetic influence was removed the particle jumped back into its original position.

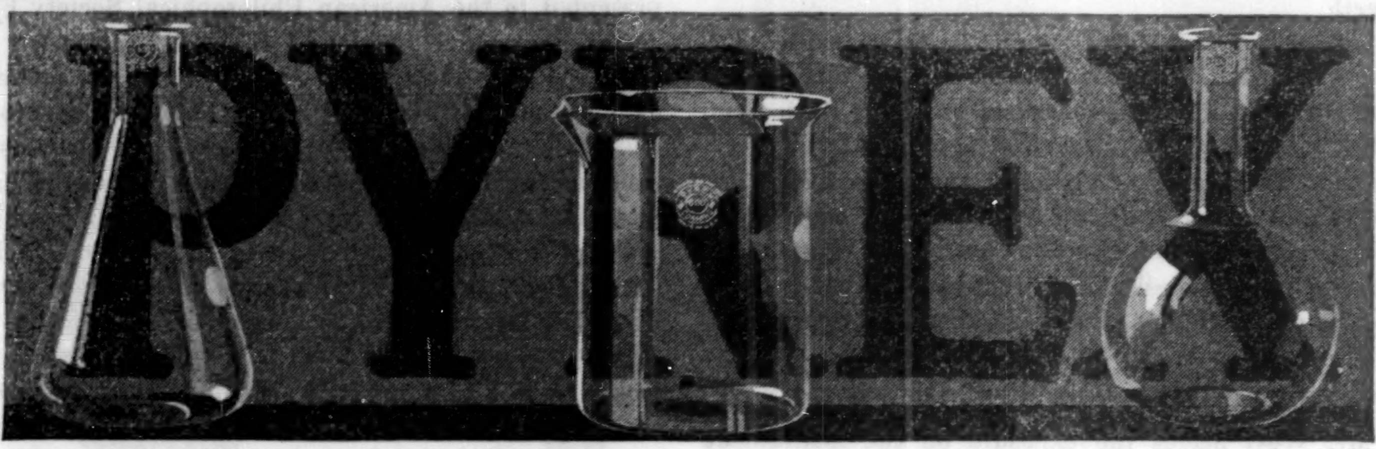
The man who has penetrated the depths of space farther than any one else living or dead told the American Philosophical Society on April 24 about the evolution of great stellar systems now taking place at distances so remote from the earth that it takes light millions of years to travel here at the rate of 186,000 miles a second.

He is Dr. Edwin P. Hubble, astronomer, who, with the aid of the largest telescope in the world, the great 100-inch, on Mt. Wilson, California, has proved that minute patches of light, most of them not even visible to the naked eye, are actually great universes of stars, similar to the Milky Way, that can be seen crossing the sky on a fine, clear night. That great eight-foot mirror, collecting faint light from distant nebulae and imprinting it on photographic plates, has demonstrated that these seeming gaseous clouds are in part composed of stars, many of them more gigantic than our sun.

Dr. Hubble's researches furnish us with the material for reconstructing the history and development of our own stellar system in which the earth is a mere dull dot and the sun but a faint insignificant light. First, if we may judge by these other stellar systems just discovered by the astronomer, our universe was an irregular conglomeration of stars and nebulosity. As the universe grew older it became more regular, it took on a spiral form, great arms of stars shot out in a sort of pinwheel shape and finally the great mass of stars assumes a disc like shape similar to that of our Milky Way. Out in the great laboratory of the heavens such processes are now going on. Dr. Hubble said that in the great nebula in the constellation of Andromeda, 23 new stars had blazed forth in the last two years, indicating that things are moving faster there than in our own system.

Testimony on a solar mystery was presented by Dr. Heber D. Curtis, of the Allegheny Observatory, who told the scientists that he had discovered in the hitherto unexplored red region of the coronal spectrum a line that may be evidence of "coronium," the hypethetical sun element not yet discovered on earth or elsewhere in the universe. The gaseous corona or envelope around the earth's favorite star, the sun, came in for close scrutiny during the total solar eclipse last January when Dr. Curtis joined the expedition of Sproul Observatory, described in an address by the leader, Dr. John A. Miller, of Swarthmore. Dr. Curtis warned the scientists, however, that what is now called coronium may be some other element such as hydrogen, helium, calcium or magnesium, in masquerade.

Study of the earth to learn about the sun was advocated by Dr. Louis A. Bauer, director of the Carnegie



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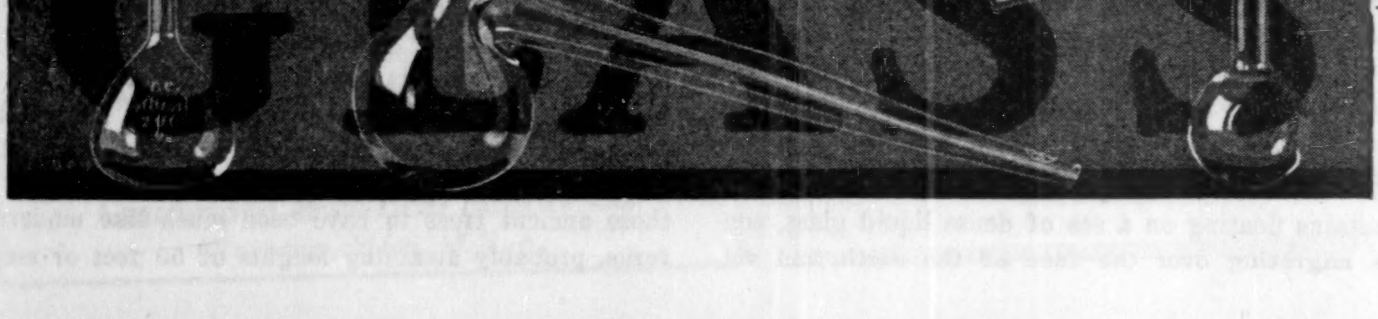

Institution's magnetic observations. He has found close correspondence between sunspots and the magnetism of the earth.

An attack on the white plague is being made with the aid of X-rays. Dr. F. Maurice McPhedran, of the Phipps Institute, told the scientists of a new device employed to take diagnostic X-ray photographs of the lungs. In the past, the motion of the heart and lungs during exposure caused a loss of detail. An electrical engineer at the University of Pennsylvania, Charles N. Weyl, aided Dr. McPhedran in designing an apparatus which overcomes this disadvantage. Between successive heart beats there is a period when the heart is at rest, but this is too brief to permit a fully timed exposure.

So Mr. Weyl makes the exposure on the installment plan during the intervals between several succeeding beats. A small glass funnel is placed over the artery on the side of the patient's neck, and as the blood rushes through it the pulse formed causes a slight pressure in a rubber tube. This acts on a small sheet of rubber, to which is attached a tiny mirror. As the rubber moves, the mirror is turned and a beam of light from a powerful incandescent bulb is reflected to a photoelectric cell, a device which gives an electric current when illuminated. Radio vacuum tubes amplify this current many thousands of times, and the amplified current is used to operate a relay which in turn makes the X-ray exposure at the proper moment.

The pressures of outflowing sap in wounded trees at this time of year may be as high as 150 pounds per square inch, equal to the steam pressure in an ordinary locomotive. This has been discovered by special instruments placed in tree trunks by Dr. D. T. MacDougal, director of the Carnegie Institution's Department of Botanical Research. Dr. MacDougal also told the society that trees with dead roots, trunk and leaves still continue to experience an ascent of sap in spring, demonstrating that this seemingly vital process is purely mechanical.

Queer green plant algae that live and thrive in complete darkness nine feet deep in the soil are being investigated by Dr. George T. Moore, director of the Missouri Botanical Garden, St. Louis. In spite of the fact that millions of them inhabit a clump of earth, their true function in life is unknown. One species of these subterranean algae is surprisingly ubiquitous. Dig a hole three or four feet deep in any part of the world and there the algae can be found.

The great menace of coal smoke to people and plants was the subject of another paper by Dr. Moore. From automatic dust counts he has figured that the average city dweller would gain 25 to 35 pounds of weight each year if the body retained all the soot and dirt that was breathed in. Raising of roses, violets and other flowers has been rendered impossible in some places by poison gas attacks due to coal smoke containing damaging amounts of acid. Most of the smoke nuisance is caused by home furnaces rather than power plants, he discovered.

Mountains floating on a sea of dense liquid glass, continents migrating over the face of the earth and volcanoes being formed by landslides of the earth's crust—such is the new picture of earth and mountain building presented to the American Philosophical Society by Professor Reginald A. Daly, of Harvard University.

It was once thought that the earth was a molten ball of fiery material with only a very thin crust between man and realistic hellfire. That idea has been abandoned because astronomers and physicists have discovered that the earth is actually more rigid and heavy than steel.

But the geologist is returning to the idea of liquids within the interior of the earth. Thirty to sixty miles deep, Dr. Daly believes, is a layer of liquid glass, under great pressure, so rigid that if it could be seen it would look like rock and yet it is so mobile that the very continents float and slide upon it. Both mountains and volcanoes owe their origin to landslides of great blocks of the earth's crust riding on this great subterranean sea of glass. The crumpling on the down side of a great slide caused mountains to rise and allowed great overflowings of the lava and gave birth to volcanoes.

North America in migrating slightly westward in ancient times caused the Rockies with their Mt. Shasta and Mt. Rainier to form, while the Alps, with the southern European volcanoes, were created when Europe decided to cuddle up closer to Africa by about 200 miles.

A great juggler of atoms and electrons, Dr. Robert Andrews Millikan, Nobel prize winner and director of the Norman Bridge Laboratory of Physics at Pasadena, California, announced that important laws in X-rays can now be applied to the kind of light that is visible to the human eye. By treating certain metals and gases to intense bombardment with 2,000 to 3,000 ampere sparks at 40,000 volts, Dr. Millikan can easily strip atoms of their planetary electrons that circle about the central nucleus. Within that miniature atomic solar system, an earth is suddenly flung off into space with an immense force. When an atom has lost an electron in this way, Dr. Millikan has found that it flies a flag, as it were, by arranging its spectral lines in a definite and unmistakable manner. It will be possible to tell just how many electrons have been lost by atoms in the stars as a result of Dr. Millikan's work.

The great family of Proboscidea, in which the modern elephant, his ancestors and his kin belong, was declared by Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, New York, to rival man in its migrations and adaptations. Fastidiousness about food led the elephants to choose the same general locations selected by man and the horse for their habitat, he said, in pointing out that although the elephant roamed America millenniums before the days of circuses, his original home was in Africa.

A hundred million years ago, many millions of years before man himself appeared on the earth, there grew a forest, near what is now Gilboa, New York. Dr. John M. Clarke, New York state geologist and paleontologist, pronounced this grove the oldest known forest. He has resurrected it from the remains in the rocks and he finds those ancient trees to have been much like modern tree ferns, probably attaining heights of 50 feet or more.

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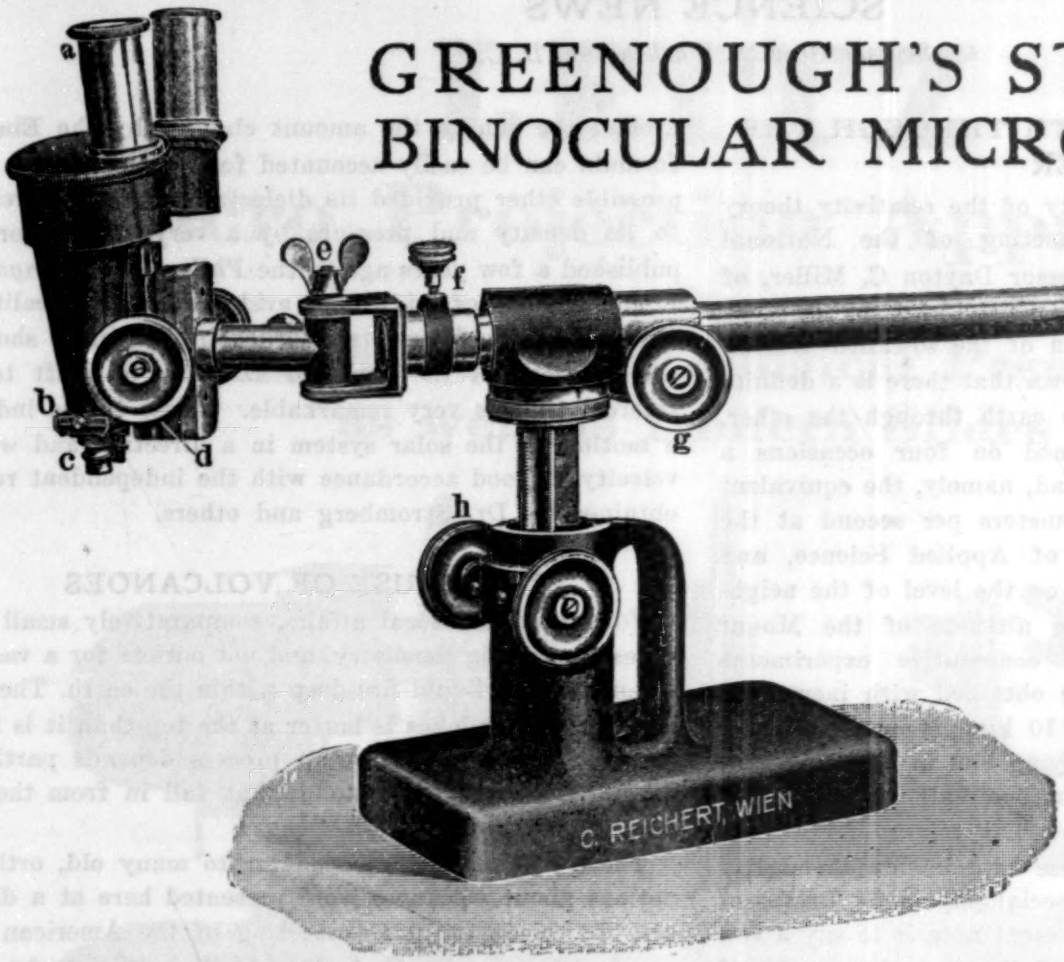

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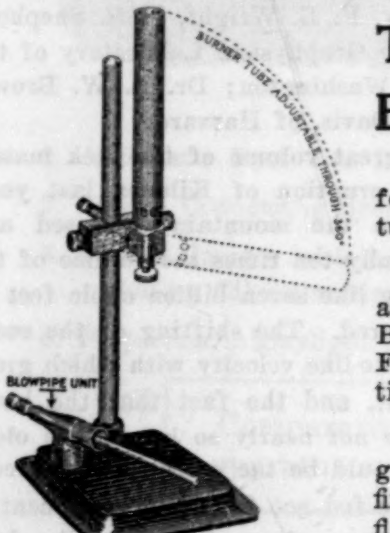

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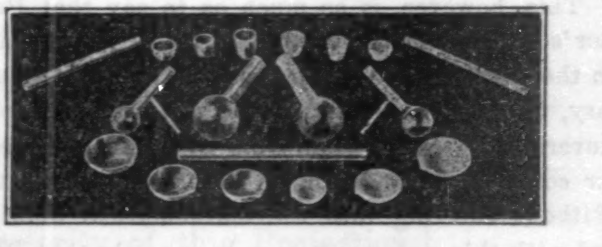

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SCIENCE NEWS

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MOTION OF THE EARTH THROUGH THE ETHER

EVIDENCE against the validity of the relativity theory was unfolded before the meeting of the National Academy of Sciences by Professor Dayton C. Miller, of the Case School of Applied Science, who, by a much refined and improved repetition of the so-called Michelson-Morley experiment, has shown that there is a definite and measurable motion of the earth through the ether.

Professor Miller has obtained on four occasions a small positive effect at Cleveland, namely, the equivalent of a velocity of about 2 kilometers per second at the altitude of the Case School of Applied Science, and about 3 kilometers per second on the level of the neighboring hills. Whereas at the altitude of the Mount Wilson Observatory in four consecutive experiments spread out over four years he obtained with increasing precision a positive result of 10 kilometers per second, his last result this April justifying him in asserting that the result is correct to within one half kilometer per second.

The technical details of these experiments themselves will be described shortly in special papers by Professor Miller. The purpose of the present note is to say a few words about the implications of these results as viewed from the standpoint of the relativity and the ether theories.

In the first glance then this definite result is entirely antagonistic to the Einstein relativity theory, which in fact could not be adapted to these results of Professor Miller by any conceivable modifications, unless the very fundamental principles of Einstein's theory were given up. This, however, is as much as to say that Professor Miller's results knock out the relativity theory radically.

In the second place, from the point of view of an ether theory, this set of results, as well as all others previously discovered, are easily explicable by means of the Stokes ether concept, as modified by Planck and Lorentz.

Without entering into the mathematical details associated with this statement we may say only that Professor Miller's results as obtained in Cleveland and Mount Wilson are given immediately by the main property of such an ether, namely, to adhere almost completely to the surface of the earth, and therefore share almost entirely its translational motion over its surface and to have a gradually increasing velocity relative to it when we go higher and higher up.

In the third place, the result of the recent rotational terrestrial experiment at Clearing, Ill., near Chicago, which gave a full effect associated with the spinning motion of the earth, can be accounted for by making the natural assumption that our globe, being almost perfectly spherical and having a purely gravitational grip upon the ether, does not appreciably drag it in its rotatory motion. Also the deflection of the light rays around the sun to the amount claimed by the Einstein formula can be easily accounted for by means of a compressible ether provided its dielectric constant is related to its density and pressure by a very simple formula published a few years ago in the *Philosophical Magazine*.

The amount of additional evidence for the reality of Professor Miller's results afforded by his tables showing the relations of the observed azimuths of drift to the sidereal time is very remarkable. These tables indicate a motion of the solar system in a direction and with a velocity in good accordance with the independent results obtained by Dr. Stromberg and others.

THE CAUSE OF VOLCANOES

VOLCANOES are local affairs, comparatively small test-tubes for cosmic chemistry, and not outlets for a vast interior mass of liquid fire deep within the earth. The lava in their boiling lakes is hotter at the top than it is in its depths. And the heating-up process depends partly on oxygen extracted from stones that fall in from the surface.

These and other ideas counter to many old, orthodox notions about volcanoes were presented here at a discussion on volcanism at the meeting of the American Geophysical Union. Dr. T. A. Jaggar, the scientist who chose the rim of the great Hawaiian volcano Kilauea as his dwelling place, led the discussion. Other participants were Drs. Arthur L. Day, F. E. Wright, E. S. Shepherd and R. B. Sosman, of the Geophysical Laboratory of the Carnegie Institution of Washington; Dr. E. W. Brown, of Yale, and Dr. W. M. Davis, of Harvard.

Dr. Day told of the great volume of the rock masses concerned in the great eruption of Kilauea last year, when the old fire-pit in the mountain collapsed and formed a new opening fully ten times the volume of the old, into which something like seven billion cubic feet of rock and gravel disappeared. The shifting of the scene of steam emission, the rifle-like velocity with which great boulders were hurled out, and the fact that the lower parts of the crater were not nearly so hot as the older theories had indicated would be the case led to the conclusion that volcanoes are fed not from one great central shaft, but from a number of smaller, root-like lava channels.

Volcanoes are commonly thought of as growing mountains. Dr. Jaggar declared that they really sink more than they rise. Kilauea, he said, rose during the period 1912 to 1920, but is sinking now. Seismographic instruments indicate also that the mountain tilts from side to side in relatively short periods. The lava in the crater has a fluctuating level, a grand explosive eruption being always preceded by a deep recession of the lava, which apparently allows surface water to enter the hot tube, generating vast quantities of steam.

Dr. Shepherd and Dr. Sosman offered explanations of

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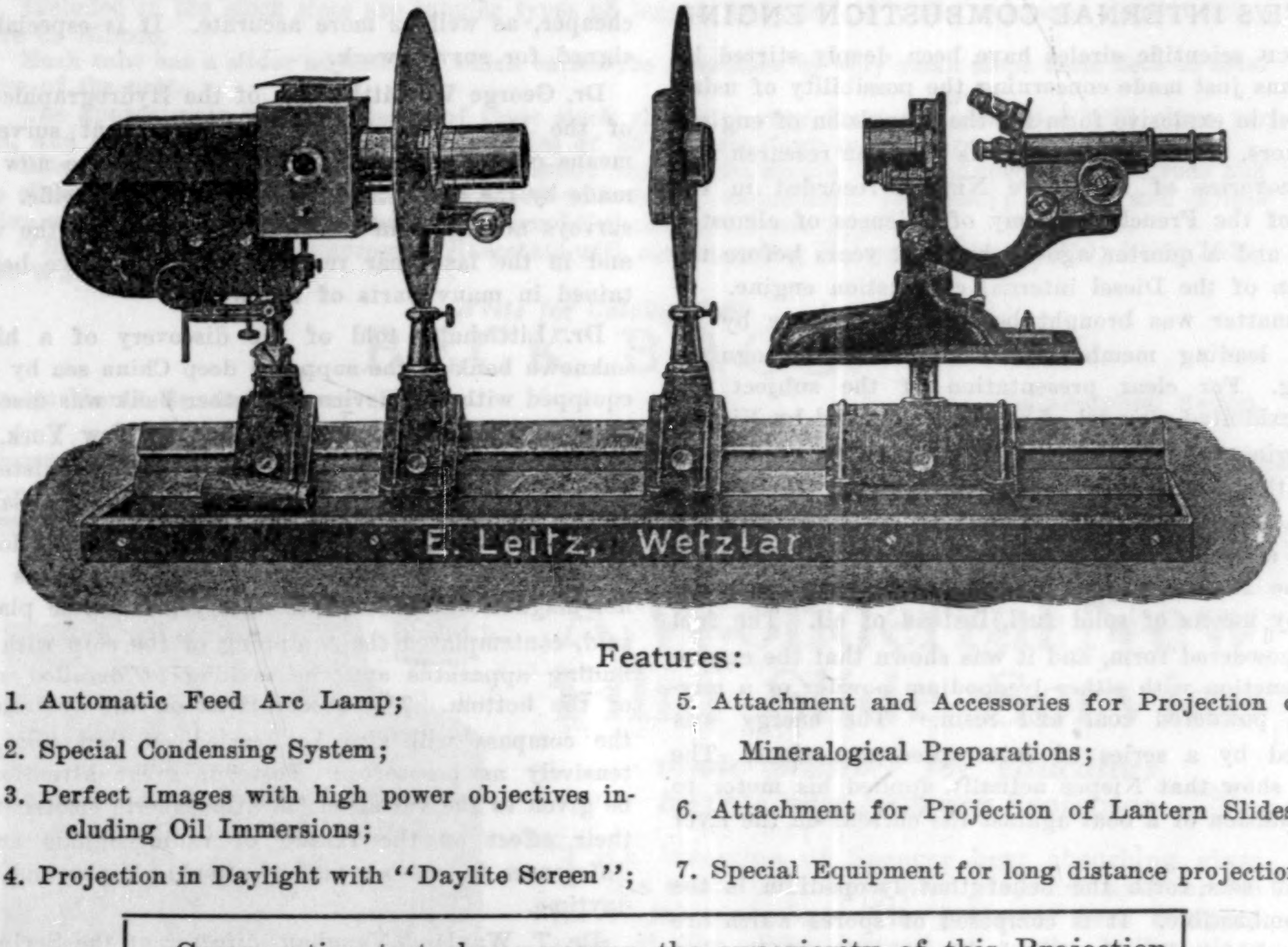

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some of the puzzling chemical phenomena of volcanoes. Apparently much of the heat that keeps lava liquid and supplies energy for the steam explosions comes from chemical combinations going on near the surface. Carbon monoxide, gaseous sulfur and hydrogen are among the gases present in lava. Present also are the results of the oxidation of these gases, that is, carbon dioxide, sulfur dioxide and water vapor, giving evidence that chemical processes are going on all the time. The source of the oxygen presented a puzzle. It was pointed out, however, that the vast quantities of rock that slide into the crater during a collapse like that at Kilauea last year contain much oxygen combined with iron. The heat roasts out this oxygen, which can then recombine with the other elements.

NIEPCE'S INTERNAL COMBUSTION ENGINE

FRENCH scientific circles have been deeply stirred by revelations just made concerning the possibility of using solid fuel in explosive form for the propulsion of engines and motors. The announcement is based on research into the discoveries of Nicephore Niepce, recorded in the annals of the French Academy of Sciences of almost a century and a quarter ago—a hundred years before the invention of the Diesel internal combustion engine.

The matter was brought before the academy by M. Rateau, leading member and scientist of recognized standing. For clear presentation of the subject the savant exhibited a model of an engine devised by Niepce. This engine was described in the proceedings of a meeting of the academy held on December 15, 1806. The Rateau model was a reconstruction produced by M. Clerget, a well-known acronautical engineer of Paris.

In the Niepce engine internal combustion was produced by means of solid fuel, instead of oil. The fuel was in powdered form, and it was shown that the engine could function with either lycopodium powder or a mixture of powdered coal and resin. The energy was furnished by a series of interrupted explosions. The records show that Niepce actually applied his motor to the propulsion of a boat against the current on the river Saone.

Rateau sets forth the belief that lycopodium is the ideal combustible. It is composed of spores which are exceedingly small, of regular dimensions and burning rapidly without leaving ash. He expresses the belief that the future holds promise of developing the use of solid fuel in the cylinder motor.

Niepce was one of the inventors of photography with Daguerre. He perfected the system of heliography now used by armies throughout the world.

A NEW SOUNDING DEVICE

PERFECTION of a new sounding device especially designed for the speedy mapping of the ocean floor by means of echoes from the sea bottom, was announced at the recent meeting of the American Geophysical Union, by Dr. H. C. Hayes, U. S. Navy physicist and inventor of the sonic depth finder and other submarine signalling devices.

The new apparatus will be given a rigorous test on the U. S. S. *Dallas* within the next few weeks and is expected to displace the larger and more costly machines now in use.

The present sonic depth finder was not designed for survey work, Dr. Hayes explained, but was originally designed during the war as a means of finding the range of an enemy ship by triangulation. The idea of sending a sound to the ocean floor and determining the distance to the bottom by the time it took to receive the echo was conceived when he was unable to get two ships for experimental purposes as at first planned.

The application of the range finder to survey work was so promising that it was never used for the purpose for which it was built. The new depth finder is similar in operation to the old, but is much smaller and cheaper, as well as more accurate. It is especially designed for survey work.

Dr. George W. Littlehales, of the Hydrographic Office of the Navy, reported to the union that surveys by means of the original sonic depth finder are now being made by the battle fleet operating in the Pacific. These surveys are made in the ordinary course of the voyage and in the last year remarkable results have been obtained in many parts of the world.

Dr. Littlehales told of the discovery of a hitherto unknown bank in the supposed deep China sea by a ship equipped with this device. Another bank was discovered by a ship traveling from Gibraltar to New York, while another vessel quickly demonstrated the non-existence of a bank reported in the Pacific off San Diego, Calif.

Captain J. P. Ault, of the Carnegie Institution, announced plans for the resumption of the cruises of the non-magnetic ship *Carnegie* next year. These plans, he said, contemplated the equipping of the ship with depth finding apparatus and the making of detailed surveys of the bottom. The observations on the variations in the compass will also be carried on, but not so intensively as heretofore. Instead, great attention will be given to the variations in atmospheric electricity and their effect on the fading of radio signals and the differences in radio communication at night and in the daytime.

Dr. T. Wayland Vaughan, director of the Scripps Institution of the University of California, told of the results of research to discover the food value of sea water. Microscopic plants and the minute animals that live on them furnish the food for many fishes. The Scripps Institution is studying the numbers of these tiny creatures in a given volume of water and their relations to the fisheries and the variations in numbers according to temperature, saltiness and other conditions of the sea water.

THE CLASSIFICATION OF RACES BY BLOOD TESTS

BLOOD tests which may show remarkable similarities in heredity between races hitherto considered unrelated were reported by Dr. Reuben Ottenberg, of New York

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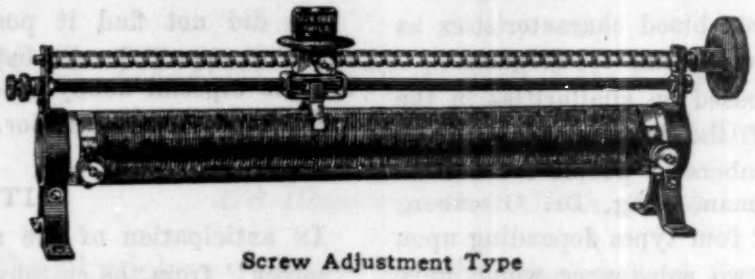

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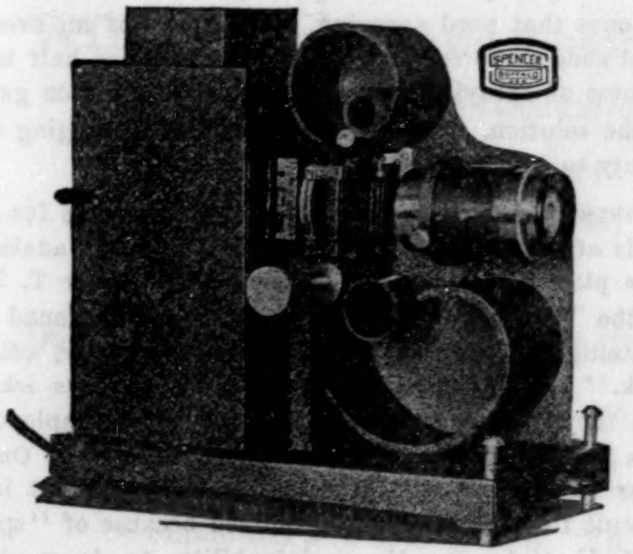

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City, to the American Association of Immunologists meeting in Washington.

Japanese were classed with the South Chinese and Hungarians. Manchurians were placed with the Hindus of India. Senegalese negroes, Madagascans and South Asiatics were grouped together. American Indians and aboriginal Australians were put in the same class; while Spanish Jews showed the same blood characteristics as Arabs, and German Jews were similar to Germans.

These classifications were based on similarities in the proportion of individuals of the four heredity blood types found among large numbers of people from these different regions. Every human being, Dr. Ottenberg explained, has blood of one of four types depending upon the presence or absence of two substances which have been found to be hereditary. One type has substance A. A second type has substance B. A third type has neither A nor B, while a fourth and relatively rare type has both A and B.

The proportion of individuals of the different types, however, varies in different geographical regions, tests made for transfusion operations show. Grouping those regions which showed similar proportions of individuals of the three main types, Dr. Ottenberg formed six classes which he called: European, Intermediate, Hunan, Indo-Manchurian, African-South Asiatic and Pacific-American.

Whether these groups represent biochemical races or show similarities which have arisen in different regions entirely independently, Dr. Ottenberg declared it was too early yet to state. More data from more parts of the earth are needed to complete the blood map of the world or permit any sound conclusions to be reached as to just what these highly interesting findings indicate.

THE MENTAL ABILITY OF CRIMINALS

THAT criminals not only hold their own with the rest of the world in ability to pass mental tests, but even stand a little in advance of it, is made known by an extensive investigation carried on by Dr. Carl Murchison, professor of psychology in Clark University.

Disregarding geographical distribution and basing his conclusions on some thousand cases, Dr. Murchison found that out of every hundred white, native, male criminals, 29 had an intelligence level of C, as measured by the Alpha Army test. This is practically the same proportion of C men found in the white draft, which may be taken as fairly indicative of the white adult male population of the United States. But of the remaining 71 criminals in each hundred, 39 had an intelligence level above C and 32 below C, while for the army out of every hundred only 33 were above C while 38 were below. Unless other conditions account for the differences, the criminals would seem to be slightly better endowed with gray matter than the army men were. Comparison of white criminals for Illinois, Indiana, New Jersey and Maryland separately with the white draft from each state shows similar results.

Dr. Murchison obtained his data in part while chief psychological examiner at Camp Sherman, Ohio. Later he personally tested prisoners in certain prisons in Ohio, Illinois, Indiana and Maryland, and also obtained data on prisoners in New Jersey.

Dr. Murchison discovered that criminals confined within their native states have a lower mental ranking than those who have migrated to other states. He sees in this fact a selective process which keeps men with more alert minds on the move.

He did not find it possible to relate all types of crime to mental levels, but found that crimes of fraud are the especial hobby of superior intellects and crimes against sex of the inferior.

ITEMS

IN anticipation of the nuisance of showers of fluffy "cotton" from the cottonwoods used in many places for shade trees, Dr. W. H. Long, of the U. S. Bureau of Plant Industry, in a statement to the American Forestry Association describes a method for killing the blossoms with a sulfuric acid spray, and thereby preventing the development of the downy seeds later on. The spray consists merely of a two per cent. sulfuric acid solution—one gallon of concentrated acid to forty-nine of water, applied with the usual type of tree-spraying apparatus. Because of its corrosive nature, the liquid should be handled only with copper or brass pumps and other apparatus. Since the "cotton" is produced only by the female, or seed-bearing trees, these alone need to be sprayed. The trees that produce the large, conspicuous catkins, or "red neckties," are staminate or male, and never bear cotton. The pistillate or female catkins are produced on separate trees at the same time as the more conspicuous male clusters, and are much smaller, greenish clusters, protruding very little from the opened buds. These are the ones that need spraying. Treatment of an average-sized shade tree requires from seven and one half to ten minutes of spraying, and consumes ten or fifteen gallons of the solution. The cost per tree varies, ranging from twenty to thirty cents.

GIRLS of active intelligence are not desirable for some kinds of monotonous jobs. In a study of 375 adolescent girls placed in industrial positions, Dr. Emily T. Burr, of the Vocational Adjustment Bureau, has found that "intelligence may be a detriment to steady, efficient work." Bright girls find uninteresting tasks irksome and they become restless and find other employment, thus adding to the large turnover of labor. On the other hand, girls who are assigned to work that is too difficult for them are soon dismissed because of "spoiled goods," "slowness," or "inability to learn job." Girls whose mental age is seven years and six months make satisfactory packers of small articles not easily damaged, such as placing powder puffs in small oiled envelopes. But the packing of fragile hair nets, each of which has to be carefully picked out of a large quantity and folded, demands a mentality of at least nine years and nine months. The simplest sewing machine jobs, such as window shades, are readily handled by girls whose mental age is twelve years. But straight seam sewing and the sewing on of braids and bindings requires an intellectual level of thirteen years.

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SCIENCE NEWS

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ETHER DRIFT EXPERIMENTS AND THE EINSTEIN THEORY

NEW light on the question of the relation of matter to the ether of space comes from the experiments by Professors A. A. Michelson and H. G. Gale, of the University of Chicago, reported to the National Academy of Sciences at its recent meeting.

The plan of it was based upon an ingenious idea suggested by Michelson in 1904 and recently urged by Dr. Ludwik Silberstein, of Rochester, as a test of the relativity theory. Suppose we had a big steel pipe running around the world on an east and west line and mirrors so arranged in it that they would reflect a ray of light all the way around. Let us then send one ray east and the other west and match them up when they come back from their circuit of the earth to see if one took longer than the other. Now if the earth does not revolve, of course the ray going east will get back in just the same time as the ray going west. But if the earth is moving from west to east, the ray running east will take longer to return to the starting point than the ray running west because that point has moved eastward in the meantime.

They enclosed a certain area of the earth's surface at Clearing, Ill., near Chicago, by a rectangle of air-tight water-pipe a foot in diameter. The pipes were laid level underground and the air was exhausted by means of a pump to about a fiftieth of an atmosphere so as to avoid interference with vision due to air currents. The light from a slit in front of an arc lamp at one corner was directed against a glass plate coated with a thin film of gold and set at an angle so that half the ray of light passed through it and so straight ahead along the pipe, while the other half was reflected at right angles and so sent around the rectangle in the opposite direction. At each of the other three corners a mirror was placed in the pipes so as to reflect the rays along the next side of the rectangle.

The two rays having traveled more than a mile by opposite routes were matched to see whether their waves coincided or whether one had fallen behind the other owing to the earth's rotation. A shorter circuit was used to establish the zero point. The fringes, or alternate dark and bright lines, due to interference of waves were viewed through a seven-foot telescope and measured with a micrometer.

Two hundred determinations were made on various days and by different observers, and the average gives a displacement of the interferometer fringes, due to the earth's rotation, of about one quarter of a fringe. The exact figure found in the experiments is 0.23 while the figures calculated in accordance with Einstein's theory is 0.24. This is a remarkably close agreement, considering the difficulty of such an experiment, and proves that the ether is not appreciably dragged along with the earth in its rotation. If the observations had shown no displacement of the fringes the experiment would have been contrary to the special relativity theory of Einstein, but the results obtained may also be interpreted in harmony with the older theory of a stagnant ether so are not decisive between them.

Michelson's new experiments are incompatible with his experiments of 1881–87 from the standpoint of the old either theory, but they may be reconciled by adopting the Einstein point of view.

THE TEMPERATURE OF THE CORONA

NEW temperature determinations on the corona of the sun, based on observations made during the recent total eclipse, indicate that it is only about one half as hot as had been indicated by earlier work. The new calculations were made by Dr. W. W. Coblentz, of the U. S. Bureau of Standards.

According to Dr. Coblentz, the coronal temperature is about 3,000 degrees absolute, or approximately 5,000 degrees Fahrenheit. The earlier figures, computed in 1908, placed it at 6,000 degrees absolute, or 10,000 degrees Fahrenheit.

The corona, or pearly halo seen about the sun during the brief period of totality, is made up partly of either very finely divided solid particles or droplets of liquid elements. What these elements are there is no way of determining, for only glowing gases give light that may be analyzed with the spectroscope. At the temperatures that prevail in and near the sun, however, it is safe to conjecture that only the heavier elements would escape reduction to a gaseous state, and so be found as solid particles or liquid drops.

Bureau of Standards workers also investigated the red and green spectral lines of the hypothetical element "coronium," which appeared in the spectrographs of the recent eclipse. No element so far known on earth makes lines in the particular positions occupied by the "coronium" lines; but until other evidence can be found astrochemists are conservative about admitting its actual existence as an element. It is surmised by some to be an unknown form of a known element.

EARTHQUAKE PREDICTIONS

EARTHQUAKE predictions issued by an Italian scientist, Professor Bendandi, which have been published in America and which seem to have coincided with some recent earth shocks, have been severely criticised as unscientific and unfounded by Professor G. Agamemnone, declared to be the ablest Italian seismologist of the present time.

According to a published statement that has been received from Rome by scientists in Washington, Professor Agamemnone declared: "Bendandi evidently works on the laws of chance and predicts enough earthquakes to

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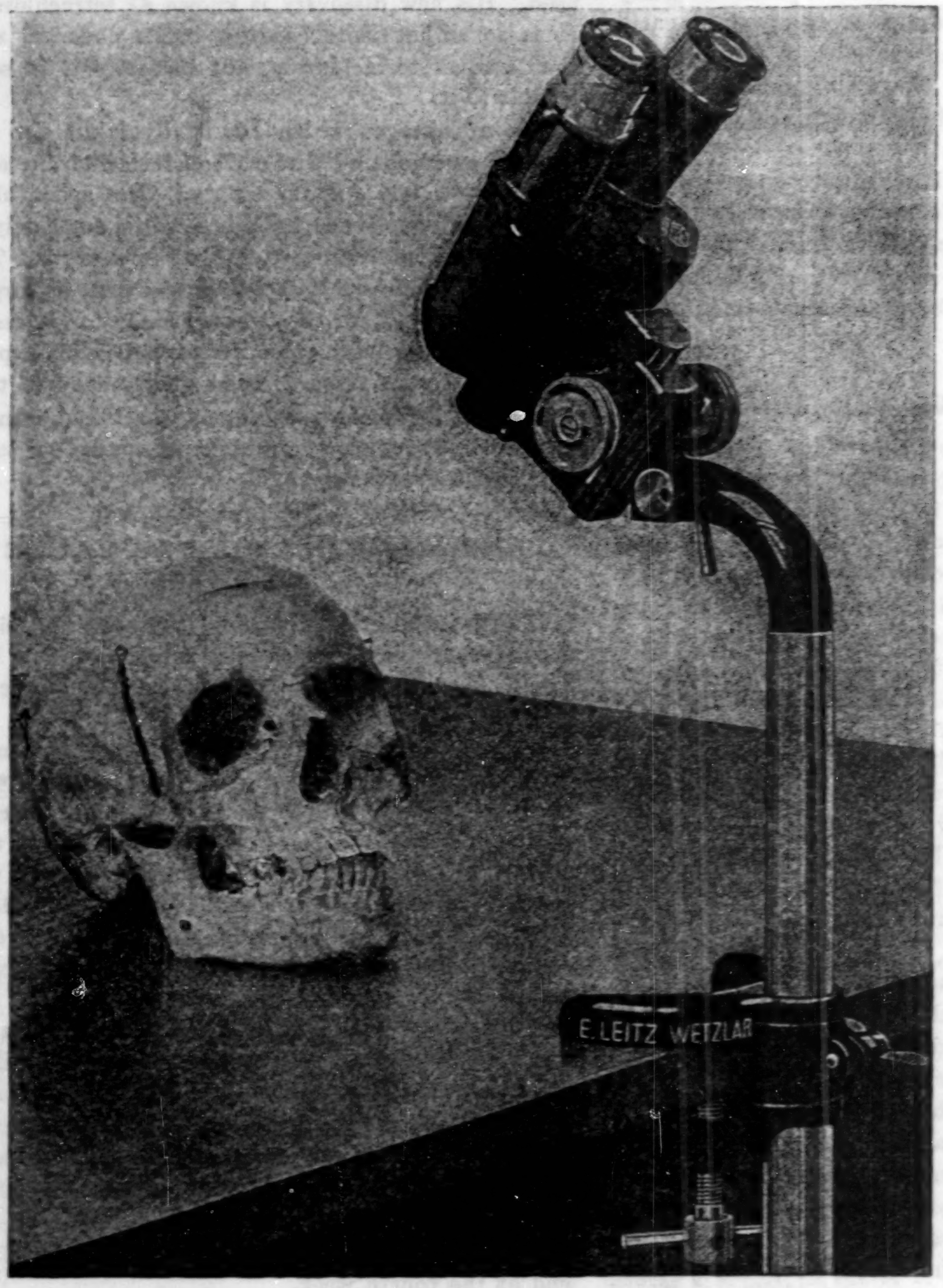

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have a fair average of success. He asks 24 hours leeway in his predictions, and with this and the number that actually occur he could scarcely fail to be right sometimes. His attempt appears to be a sensational effort to do something which many eminent scientists have worked on but in which they have as yet had little success.''

Professor Agamemnone says, however, that there is no kind of phenomena which lend themselves so readily to prediction as seismic phenomena. Over a period of thirty years there have been an average of thirty-eight earth tremors a month in Italy and therefore a prediction is nearly certain to be fulfilled. The Philippines have practically the same frequency, while Japan has 1,500 shocks a year or 4 a day.

It is understood that the Italian government decided that Bendandi's predictions for Italy were, regardless of their correctness, hurting the tourist trade and he was suppressed so far as Italy is concerned. Bendandi then transferred his activity and bestowed his predictions on other parts of the world.

SURVEY OF FRESH-WATER RESOURCES

THE little-used and little-known food resources of American rivers, lakes and ponds are the subject of a research program projected by the division of biology and agriculture of the National Research Council. Professor Maynard M. Metcalf, chairman of the division, is at present engaged in organizing a committee for the purpose of making a preliminary canvass of the situation and determining what program of action should be adopted.

''This is not merely a question of fisheries,'' said Dr. Metcalf. ''To obtain the information needed for a real knowledge of the food possibilities of our fresh waters we need to have the points of view of many types of scientists. We need the point of view of the aquatic botanist, for the foundation of all the life in the waters lies in the green plants, most of them of microscopic size, that capture chemical elements and sunlight and manufacture the basic foodstuffs. We need the point of view of the aquatic zoologist, for these microscopic plants are eaten by microscopic animals, which in their turn are victims of water insects and small crustacea. These in turn are food for smaller fish, and the little fish are eaten by the big ones; and here we need the fish expert. We need the chemist's point of view, for all life in the waters is very sensitive to chemical changes. And finally, we need the help of the pathologist and bacteriologist, for water life, like all other life, is subject to diseases.''

Dr. Metcalf said that his interest in the possibilities of exploitation of the waters, or ''aquiculture,'' was first roused during a sojourn in a Bavarian city, where a population of about 80,000 had been abundantly supplied with fish out of one small river for hundreds of years. He thinks it possible that a considerable part of the answer to the question of food needs for the increasing population of America can be met in the neglected waters of our rivers, lakes, marshes and small ponds. The small pond on the farm is an object of especial interest. Professor Metcalf stated that he would like to see every farmer in a position to raise his own fish.

A NEW HOOKWORM CURE

A NEW and highly efficient cure for hookworm was described before the recent meeting of the American Society for Tropical Medicine by Drs. Maurice C. Hall and J. F. Shillinger, of the U. S. Department of Agriculture. Dr. Hall is the discoverer of the use as a hookworm remedy of the common cleaning fluid carbon tetrachloride, which has largely replaced the chenopodium oil formerly used. His new discovery is known as tetrachlorethylene. It is somewhat more complex in its chemical structure than carbon tetrachloride, but basically it is somewhat similar to it.

The advantages which Dr. Hall claims for the new remedy, as compared with carbon tetrachloride, are equal effectiveness and greater safety. One spoonful of the older remedy, followed by Epsom salts, commonly suffices to clear up an ordinary case of hookworm. The new treatment requires a dose only two thirds as large. The factor of safety, Dr. Hall says, seems to be very large. Heavy overdoses may cause illness, but in his experiments with dogs he has given as much as one hundred times the curative dose before the animal was killed. In regular medical and veterinary practice, of course, no such overdose would ever be given.

LIGHT-TREATED MILK AS A CURE FOR RICKETS

LIGHT-TREATED milk instead of cod-liver oil is the ''good medicine'' for children announced by Dr. Benjamin Kramer before the American Pediatric Society meeting, held in Washington, D. C.

Rickets, a disease of children's bones due to lack of lime and phosphorus, has long been treated with cod-liver oil, though nobody knew just why. Recently an anti-rachitic vitamin has been shown to exist in the nasty stuff. At the same time researches were going on which have shown that the invisible short-length or ultra-violet light rays have the power to prevent rickets, either by exposing children to them directly, or by exposing certain foods to their action.

Dr. Kramer made a critical test of this action on milk. Eight children who were severely afflicted with rickets were given daily rations of milk which had been exposed for two hours to the action of ultra-violet light from a quartz mercury vapor lamp. X-ray pictures, which Dr. Kramer exhibited, showed that the bones of these children began to heal by the end of the third week of this treatment, and that the cure was well advanced by the end of the fourth week.

The changes in the bones and blood were similar to those which followed the administration of cod-liver oil or the exposure of the child itself to radiations from the quartz mercury vapor lamp.

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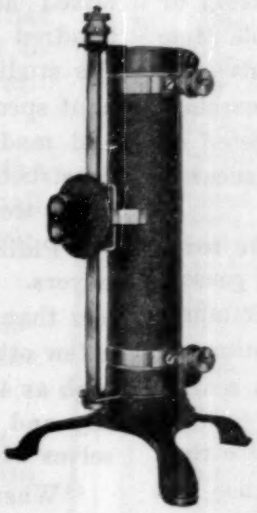

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ease; injected deeper and in larger doses it causes the body to build up resistance against it. The details of the successful campaign against this malady will be told by its conquerors, Drs. George F. and Gladys H. Dick, of the John McCormick Institute for Infectious Diseases, in the next issue of the *Journal* of the American Medical Association.

The Dick test for susceptibility to scarlet fever is not unlike the Schick tests for susceptibility to diphtheria. A toxin solution is prepared by planting the bacteria of scarlet fever in sterile broth, and after a suitable time allowed for their growth, removing the germs and sterilizing the broth by passing it through a porcelain filter. The strength of the toxin must then be tested on human volunteers, for animals can not be used successfully in these tests.

After the strength is determined, a little of the toxin solution is injected into the skin of the suspected person. If no reaction follows, the person is judged immune. If a pinkish or red discoloration the size of a dime or larger takes place, the person is likely to develop scarlet fever in case he is exposed.

Much larger doses of the same kind of toxin are then injected into the subject's tissues. These may cause him to feel vaguely ill, but the malaise soon passes, and in the meantime his system has developed an antitoxin that has destroyed the injected toxin, and has the power of neutralizing the results of any subsequent natural exposures to the disease. Tests since the discovery of this toxin have shown that non-immune persons properly inoculated become immune within two weeks and remain so for at least eighteen months.

The investigators state that an antitoxin has also been developed, using horses' blood, after the fashion of the diphtheria antitoxin. This is now being used with success in the treatment of cases of active scarlet fever. Its use is not recommended, however, for prevention, because the passive immunity conferred is short-lived as compared with the active immunity developed by the use of the toxin itself.

FORESTRY IN PHILIPPINES

THE costly experience of forest destruction in the United States proper is being turned to advantage in the development of the tropical hardwood forests of the Philippines, Major George P. Ahern, trustee of the Tropical Plant Research Foundation, has stated in an interview with a Science Service representative.

Lumber companies operating over large tracts are not being given a free hand with the forests, Major Ahern said, but are granted twenty-year cutting concessions, for which they pay stumpage running from $10 to $20 per acre cut over, and which are renewable if properly handled. The areas granted are large enough so that a given company will require eighty or ninety years to make the first cutting, which gives plenty of time for second growth timber to develop. Complete clearing is not permitted, except where it can be shown that the land is of greater value for farms than for forests. Elsewhere, as a rule, all trees less than sixteen inches in diameter must be left standing.

"When we first started operations," Major Ahern said, "firms with experience in tropical forestry told us that modern logging machinery could not be used. We used it. We put in light railways to bring the timber out, and did away with animal transport and with much of the manual labor. They told us, too, that only the few valuable woods would pay for the cutting. We are taking many other kinds of wood, which are now in high demand for veneer. They told us that a forest so mixed as ours, which comprises at least twenty-five hundred tree species, could not be handled profitably. We studied the possible uses of some twenty odd dominant species constituting about 80 per cent. of the stand, and made tables for the information of engineers and constructors, and now have a good market for everything we take out.

"Philippine mahogany, of course, is one of our best payers. The mahogany cut in Central America averages less than 2,000 feet per acre; Philippine mahogany and a few other woods in some instances run in some areas as high as 40,000 feet per acre. And the Philippine mahogany and the valuable veneer woods are replacing themselves where they have been cut.

"Where the cut-over lands are suitable, Filipinos are coming in and farming them for sugar cane and other crops. At first our concessionaires resented their presence, as 'squatters,' but I pointed out to them that they never held the land more than two or three years, after which the jungle took it back again, and the farmers had to move on to fresh fields. Moreover, the presence of these settlers means a supply of labor, and helps to build up settled communities in the forest country.

"Fortunately, we have no fire problem, other than that incidental to the shifting agriculture above mentioned. The 'slash,' which in the United States would constitute a serious menace, may simply be left on the ground in the Islands, to rot and become part of the soil. The climate is so moist that forest fires have no terrors."

ITEMS

THE Carlsbad caverns of New Mexico shelter a large and interesting population of animals, which was described before the meeting of the American Society of Mammalogists, by Vernon Bailey, of the U. S. Biological Survey, who made a study of them in connection with the recent exploration expedition of the National Geographic Society. In these great caves, and in smaller ones near by, Mr. Bailey found large numbers of bats, together with cave mice, water rats and a rare Mexican animal related to the raccoon, known as the ring-tail. Three species of skunks occupied some of the smaller caves, while gray foxes, bob-cats and mountain lions visited them less frequently. One open cave was used by mountain sheep as a refuge from the weather and from their enemies. Mr. Bailey said that he wished to correct a misimpression that has gained considerable circulation, regarding the cave mice. These animals are neither white nor blind, though they stay in the caves throughout their lives.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND LEGISLATION AGAINST THE TEACHING OF EVOLUTION

THE scientists of America, 14,300 strong, were called to the support of freedom of teaching and of evolution, when Professor Michael I. Pupin issued through Science Service the following statement in regard to the case brought in Tennessee under the recent anti-evolution law:

"As president of the American Association for the Advancement of Science I pledge support in the defense of the Tennessee teacher arrested for teaching evolution; this support to accord with the resolution of the Association's Committee of Drs. Conklin, Davenport and Osborn. The American Civil Liberties Union can count upon the Association providing scientific expert advisers in defense of Professor Scopes. This case will be a test case, which was bound to come sooner or later, and its trial will define the law, if there be any, in a lawless procedure like this arrest. Both as fair-minded scientists and as self-respecting American citizens we must aid in this trial."

Professor Pupin is the inventor of the system of loading coils on wires that makes long-distance telephony possible, and is well known to the public through his fascinating autobiography, "From Immigrant to Inventor." He holds the chair of electro-mechanics at Columbia University.

The American Association for the Advancement of Science is the largest general science society in the United States. It has 14,300 members and 86 special scientific societies are affiliated or associated with it.

Three years ago the association appointed a committee composed of Dr. Edwin G. Conklin, professor of biology at Princeton University and author of "Heredity and Environment in the Development of Man"; Dr. Charles B. Davenport, director of the Station for Experimental Evolution of the Carnegie Institution of Washington at Cold Spring Harbor, L. I., and author of "Body Build and its Inheritance," and Dr. Henry Fairfield Osborn, president of the trustees of the American Museum of Natural History, New York, and author of "Men of the Old Stone Age," to report a resolution on evolution. The resolution recommended by the committee and adopted by the council of the association reads:

"Inasmuch as the attempt has been made in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

"Since it has been asserted that there is not a fact in the universe in support of this theory, that it is a 'mere guess' which leading scientists are now abandoning, and that even the American Association for the Advancement of Science at its last meeting in Toronto, Canada, approved this revolt against evolution, and

"Inasmuch as such statements have been given wide publicity through the press and are misleading public opinion on this subject,

"*Therefore,* The council of the American Association for the Advancement of Science has thought it advisable to take formal action upon this matter, in order that there may be no ground for misunderstanding of the attitude of the association which is one of the largest scientific bodies in the world, with a membership of more than 11,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution.

"(1) The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

"(2) The council of the association affirms that the evidences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

"(3) The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

"(4) The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress."

ANTI-EVOLUTION LEGISLATION IN THE VARIOUS STATES

Tennessee

The text of the law under which the Dayton suit is brought is as follows:

An act prohibiting the teaching of the Evolutio Theory in all the universities, normals and all othe public schools of Tennessee, which are supported i whole or in part by the public school funds of the state and to provide penalties for the violations thereof.

Section 1. BE IT ENACTED BY THE GENERAL ASSEMBL OF THE STATE OF TENNESSEE, That it shall be unlawfu for any teacher in any of the universities, normals an all other public schools of the state which are supporte in whole or in part by the public school funds of th state, to teach any theory that denies the story of th divine creation of man as taught in the Bible, and t teach instead that man has descended from a lower ord of animals.

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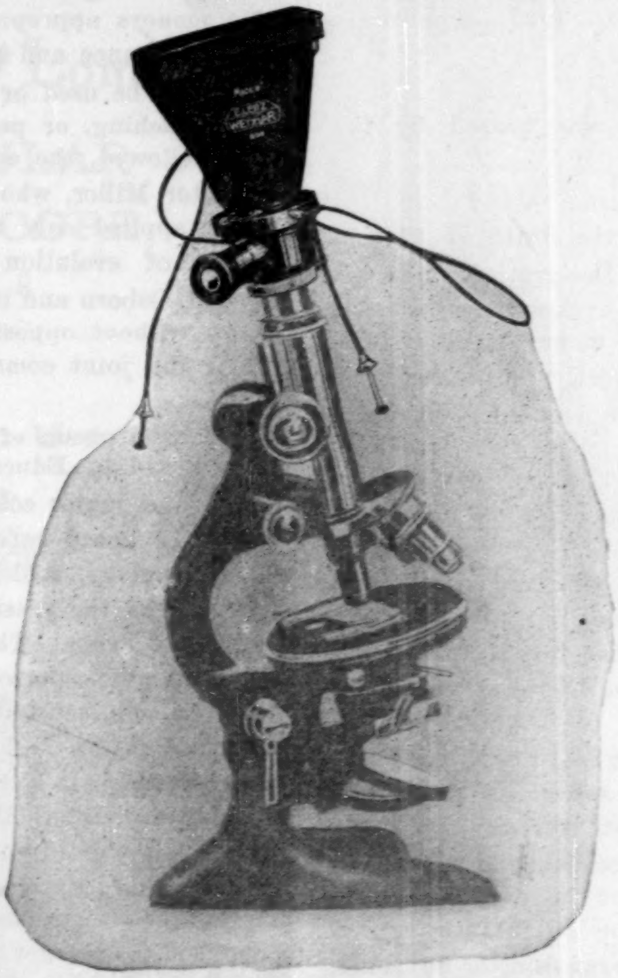

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Section 2. BE IT FURTHER ENACTED, That any teacher found guilty of the violation of this act, shall be guilty of a misdemeanor and upon conviction, shall be fined not less than one hundred dollars ($100.00) nor more than five hundred dollars ($500.00) for each offense.

Section 3. BE IT FURTHER ENACTED, That this Act take effect from and after its passage the public welfare requiring it. Passed March 13, 1925. Approved: March 21, 1925.

Florida

The following joint resolution was passed by the Florida legislature in 1923:

House Concurrent Resolution No. 7

"*Whereas,* the Constitution of the State of Florida expressly states in section 6 of the Declaration of Rights that, 'No preference shall be given by law to any church, sect or mode of worship, and no money shall ever be taken from the public treasury directly or indirectly in aid of any church, sect or religious denomination, or in aid of any sectarian institution.' And

"*Whereas,* The public schools and colleges of this state, suported in whole or in part by public funds, should be kept free from any teachings designed to set up and promulgate sectarian views, and should also be equally free from teachings designed to attack the religious beliefs of the public, Therefore,

"Be it Resolved by the House of Representatives, the Senate Concurring:

"That it is the sense of the Legislature of the State of Florida that it is improper and subversive to the best interest of the people of this State for any professor, teacher or instructor in the public schools and colleges of this State, supported in whole or in part by public taxation, to teach or permit to be taught atheism, or agnosticism, or to teach as true Darwinism, or any other (sic) hypothesis that links man in blood relationship to any other form of life."

Kentucky

In 1921 a bill forbidding the teaching of evolution in public schools and universities under penalty of a heavy fine and jail sentence, was introduced into the lower House of the Kentucky Legislature, and after a hot fight was defeated by a vote of 42 to 41.

North Carolina

In April, 1925, Representative Poole introduced the following resolution into the lower House:

"*Resolved* by the House of Representatives, the Senate concurring, that it is the sense of the General Assembly of North Carolina that it is injurious to the welfare of the people of North Carolina for any official or teacher paid wholly or in part by taxation to teach or permit to be taught as a fact either Darwinism or any other evolutionary hypothesis that links man in blood relationship with any lower form of life."

The bill was referred to the Education Committee which reported unfavorably. It was brought to the floor of the House by a minority report and defeated by a vote of 64 to 47.

In January, 1924, the High School Text-book Committee at the suggestion of Governor Morrison struck from the list of school books two well known works on elementary biology, because, as stated in the press, of their containing matter on evolution.

South Carolina

In 1921 a rider was attached to the general appropriation bill by the Senate of the South Carolina legislature providing that:

> No moneys appropriated for public education or for the maintenance and support of state-supported institutions shall be used or paid to any such school or institution teaching, or permitting to be taught, as a creed to be followed, the cult known as "Darwinism."

Senator Miller, who introduced the proviso, explained that it applied only to "Darwinism" and not to such theories of evolution as are advocated by Lamarck, Bergson, Osborn and others. The amendment passed the Senate without opposition but was stricken out of the bill by the joint committee.

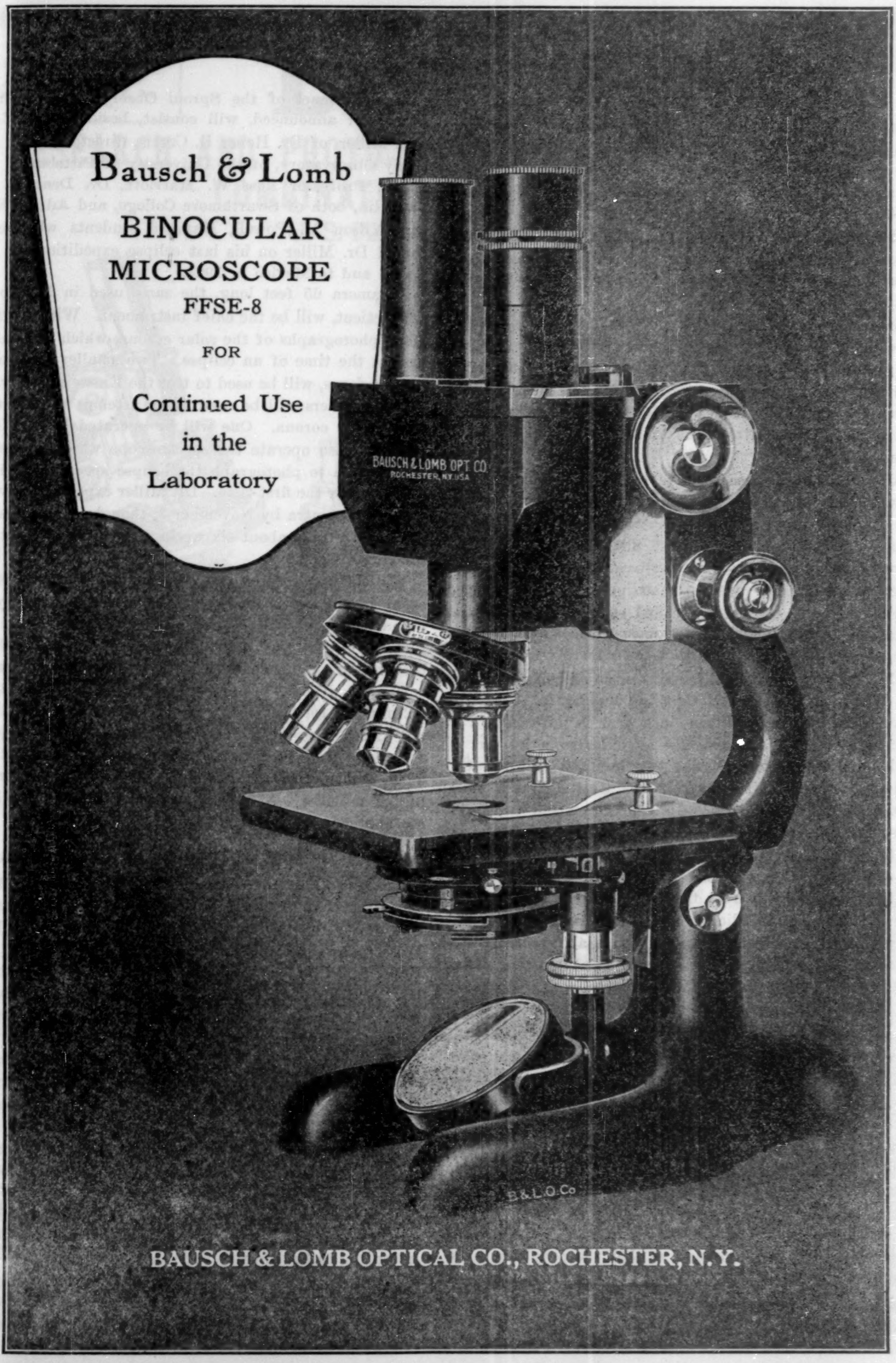
California

In 1924 a group of Fundamentalists protested to the State Board of Education against the use in the high schools and junior colleges of text-books teaching evolution. The board referred eleven text-books on general science, biology, zoology and astronomy to a committee composed of the presidents of nine California universities and colleges. The committee found no fault with the books and reported in part as follows:

> In our opinion, these books have treated the subject with moderation and circumspection. There appear to be no statements derogatory to the Bible, and in the few instances in which the possible bearing of evolution upon religion is discussed at all, the writers have taken special pains to assure the readers that there is no conflict between science and religion. Evolution is presented as a theory, and not as an established fact, although it is stated here and there that the theory of evolution is commonly accepted by scientific men, and that is true.
>
> The text-books before us are concerned with presenting scientific facts and theories of which every person with any pretense to an education in the subject or subjects treated should be informed.

ITEMS

ELECTRIC mine lamps may cause gas explosions just as readily as a match or other source of ignition according to tests just reported by the U. S. Bureau of Mines. These tests were made to determine whether the bureau had been taking unnecessary precautions in requiring a special design for electric lamps to be used in mines where explosive gas was known to exist. The present study conclusively settles the question. It has clearly proved that the methane which is found in such gassy mines can be set off by electric lamps if the little bulb is broken. Hence the bureau is reassured in its insistence that all precautions of construction now required for such lamps must be maintained. These precautions include the requirement that the lamp shall go out immediately if the bulb is broken. Thus the cause of ignition disappears at once when an accident damages the lamp so that the hot filament might be exposed.



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SCIENCE NEWS

Science Service, Washington, D. C.

MEDICAL PROGRESS

RECOUNTING the romance of modern medicine before an audience of more than four thousand doctors from all over the United States meeting in Atlantic City, N. J., for the annual seession of the American Medical Association, Dr. William D. Haggard, of Nashville, Tenn., newly installed president of the association, told how the last fifty years of medicine has witnessed more achievements of miraculous character than the five whole centuries preceding.

Enumerating some of the medical discoveries which have aided mankind he called anesthetics and antisepsis the greatest contributions, for they have made the achievements of modern surgery possible. Next to those, he considers the control of tuberculosis, yellow fever, typhoid and syphilis the greatest boon of medicine to the human race.

Although many diseases have been conquered and insulin has come to the aid of the diabetic patient, there are yet countless problems to solve. "There is yet no specific for pneumonia, which, with all the other acute respiratory diseases, destroys more lives every day than any other ailment. The causes of smallpox, measles, mumps, chicken-pox and the much-dreaded sleeping sickness are as yet undetected. Cancer, the most pitiless of all maladies, is our rebellious and still elusive foe."

Emphasizing the economic importance of being healthy, Dr. Haggard pointed out that the number of cases of sickness in the United States in a year is thirteen and a half million, and economically amounts to a loss of a billion dollars annually. The two hundred and twenty-five million sick days a year in the United States, estimated by Dr. Haggard, are equivalent to about two days of sickness a year for every person in the United States.

He urged the importance of preventive medicine and advocated for that purpose a survey of the apparently healthy, a "drive to treat the incipiently sick while they can be cured." "Medicine," said Dr. Haggard, "is the only profession which is literally and altruistically devoted to professional suicide, because it endeavors chiefly, not to cure, but to prevent disease."

THE TOTAL SOLAR ECLIPSE OF 1926

ALTHOUGH still studying photographs of the total solar eclipse which they made at New Haven, Conn., last January, Dr. John A. Miller, director, and his colleagues of the Sproul Observatory, at Swarthmore College, are getting ready to journey half around the earth, to Bencoelen, on the west coast of Sumatra, to observe the next one. This occurs on the fourteenth of January, 1926, and the path of totality, the narrow band in which the sun is seen completely obscured, passes over East Africa, Sumatra and the Philippines, so that the people who see it will be quite different from those who saw the last one, which passed over the most thickly settled part of the United States.

The personnel of the Sproul Observatory expedition, Dr. Miller announced, will consist, besides himself and Mrs. Miller, of Dr. Heber D. Curtis, director of the Allegheny Observatory, of the University of Pittsburgh, Mrs. Curtis, Professor Ross W. Marriott, Dr. Dean B. McLaughlin, both of Swarthmore College, and Adrian Rubel and Wilson M. Powell, Harvard students who accompanied Dr. Miller on his last eclipse expeditions to New Haven and to Mexico in 1923.

A camera 65 feet long, the same used in Mexico and Connecticut, will be the chief instrument. With it will be taken photographs of the solar corona, which can only be seen at the time of an eclipse. Two smaller cameras, of 15-foot focus, will be used to test the Einstein theory, and interferometers will be used in an attempt to detect motion in the corona. One will be operated by Dr. Curtis who will also operate the spectroscope which he used at New Haven to photograph the eclipse spectrum in infrared light for the first time. Dr. Miller expects to have the party in Sumatra by November 3, though he believes that it will only take about six weeks to get the apparatus in working order.

While the eclipse of last January was the only one to occur in the northeastern United States in many years, Sumatra happens to be unusually well favored during the first thirty years of the century. On May 18, 1901, one occurred of the unusually long duration of 6.5 minutes, as compared with 2.4 minutes for the one last January or 4.2 minutes for that next year. If the weather conditions are unsatisfactory in Sumatra, it will only be necessary for the astronomers to wait four years, for on May 9, 1929, still another occurs there, and that with a duration of 5.1 minutes. After that, however, Sumatra will not see another total solar eclipse until 1988.

A NEW STAR

FLASHING out from obscurity to a temporary brilliancy exceeding that of the Pole Star, a nova, or "new star" was discovered in the southern skies on May 25 by R. Watson, an amateur astronomer at the Cape of Good Hope, South Africa, according to an announcement by Dr. Harlow Shapley, director of the Harvard College Observatory. The nova is in the constellation of Pictor, the "Painter," which can never be seen from points north of the Tropic of Cancer, but which from New Zealand, South Africa and the southern part of South America, can be seen in a part of the sky as prominent as that occupied by the Great Bear for American observers.

While such new stars are not uncommon, an average of about eight or ten a year having been discovered since the Harvard Observatory, with the assistance of its southern branch at Arequipa, Peru, began to search systematically for them, one of the brightness of that in Pictor is rare. According to Dr. Shapley, it is the brightest that has been seen since August, 1920, when one appeared in the constellation of Cygnus, the Swan, or "Northern Cross." Nova Cygni III, as the astronomers refer to it, because

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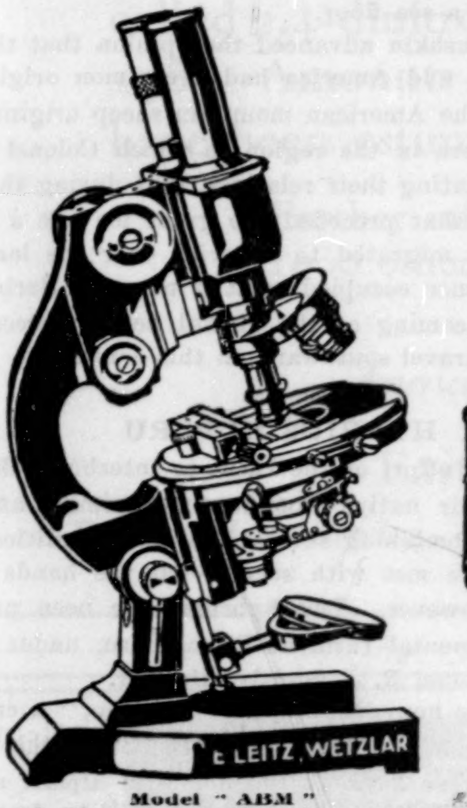

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it is the third that has been recorded in that constellation, was of the 3.5 magnitude on August 20 when it was discovered, and on the twenty-fourth it had reached the second magnitude, but by September 10, it was again too faint to be seen with the unaided eye. Nova Pictoris is being anxiously watched to see if it continues to become brighter. Dr. Shapley stated that the Harvard branch station in Peru has been notified, as well as other observatories in Argentina, Chile, Mexico and Cuba.

The cause of a nova is still in doubt, but many astronomers believe them to be due to the collision of a star with another, or to its passage through a mass of nebulous material. In such a case the friction would generate a great amount of heat, and the star would become much brighter. This theory is given support by the fact that most novas are seen to be surrounded by nebulous material for a considerable time after their outburst.

EXPLODING METEORS AND LUNAR CRATERS

MILLIONS of meteors, hitting the moon with a speed of as much as fifty miles a second, and exploding with a violence greater than that of T. N. T., dynamite or nitroglycerine, were responsible for the multitude of craters that can be seen to cover the surface of our satellite, when viewed with a telescope or even a pair of binoculars, according to a new theory proposed by A. C. Gifford, of the Hector Observatory, at Wellington. The action of the meteors was much the same as that by which exploding shells produced miniature editions of the lunar craters in the battlefields of France, when earth thrown into the air by the force of the explosion returned to the ground to form in a ring somewhat higher than the surrounding plain.

These meteors were not greatly different from those that now reach the earth, but while thousands of them enter the earth's atmosphere daily, friction with the air is so great that most are burned up before they reach ground, and when this occurs at night, a "shooting star" is the result. The few that do land have been so greatly slowed down that they can do little damage. Since the moon has no appreciable atmosphere, they hit the lunar surface with their full speed, frequently of 40 miles a second. "With this velocity," says Mr. Gifford, "if the meteor is stopped within one tenth of a second, it will penetrate two miles into the surface. In this time it is changed into a gas, but confined temporarily in a severely limited space. The pressure is so intense, the expansion so rapid, that it is instantaneously shattered and ejected by an explosion five hundred times as powerful, and much more rapid than that which would result if an equal mass of dynamite were exploded in a cavity within the lunar crust."

As further evidence in support of his theory, Mr. Gifford has calculated the shape of a crater formed in such a way, and his figures closely resemble those of actual craters seen on the moon through a telescope.

AMERICAN WILD SHEEP

THE wanderings of the animal inhabitants of the vast area of northern Asia during many thousands of years were outlined before the meeting of the National Academy of Sciences, by Professor Peter P. Sushkin, of the Russian Academy of Sciences.

During recent geological time migrations in Asia have been conditioned by two main events: first, changes in land level, causing the disappearance of a former inland sea, and second, the glacial period. About half the species of animals in northern Asia range clear across the continent as well as into northern Europe; the others are more local in their distribution, and it is notable that their development has progressed much further on the great central highland than it has in the great valley that was once a sea floor.

Professor Sushkin advanced the opinion that the wild sheep of Asia and America had a common origin. He believes that the American mountain sheep originated in Asia, somewhere in the region in which Colonel Roosevelt is now hunting their relatives, that during the mild-climate times that preceded the great ice age a branch of the family migrated to America over the land connection that once occupied what is now the Bering Sea, and that the coming of the glacial period forced these emigrants to travel southward on this continent.

HYBRIDS IN PERU

THE age-old effort of the Incas to interbreed different species of their native wool-bearing animals and thus obtain types combining several desirable qualities seems at last to have met with success—at the hands of the white man, however. Two hybrids have been produced at the experimental farm at Puno, Peru, under the direction of Colonel R. J. Stordy, director.

One of these newcomers is the "huarizo," a cross between the llama and the alpaca, the other the "paco-vicuna," a cross between the domestic alpaca and the wild vicuna. Whether these animals will be fertile and reproduce is not yet known, according to Wilson Popenoe, agricultural explorer, who has recently returned to Washington from Peru.

The llama, one of the ancestors of the new "huarizo," has for centuries been the cow and the horse and the "ship of the Andes" to the people of Peru, Bolivia and Ecuador. It is the largest of the four cameloid types of wool-bearing animals native to this region. It is said that centuries before the European conquest it had been domesticated from the wild huanaco by the Indians who prized it as a gift from the gods, without which there would be no existence, trade or travel.

Huge numbers of these animals were said to have existed at one time. Spanish chroniclers say that 300,000 of them were used to carry the gold and silver from the mines of San Luis Potosi to the waiting galleons of the Spaniards. To-day the number is not so great, but these animals, nevertheless, are the only means of transportation, and sources of food and clothing to the large part of the population.

Although it is the largest of these animals, the llama's flesh is not exactly a delicacy, and its coat of wool is coarse and rough. The alpaca, the other parent of the "huarizo," is smaller and has a wool whose quality is prized in commerce. By interbreeding these two it was

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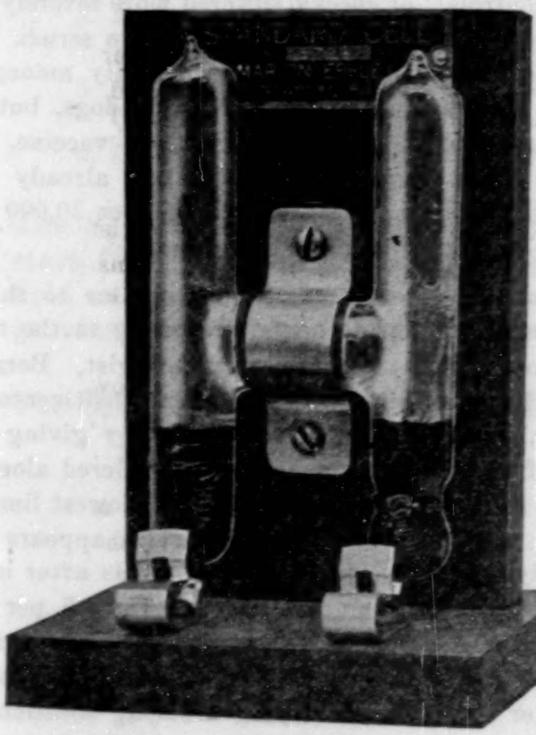

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hoped to obtain wool that was finer than that of the llama and in quantity greater than that of the small alpaca.

But the rarest of all the small humpless camel-like animals of the Andes is the vicuna. Graceful as a gazelle, it is still wild or half wild and inhabits the high mountain ranges and inaccessible places bordering the region of perpetual snow. It was a prize to the hunters seeking it among the rocky precipices of Ecuador, Peru and Bolivia. Its wool and skin have always been considered of special value, a poncho of vicuna being worth a mint of money to-day. This and the fact that it had to be killed to obtain its wool have nearly caused its extinction. There are now stringent regulations for its protection.

This graceful animal, although wild, has an amount of curiosity that often made it the victim of the hunter. It can be captured and tamed and even domesticated to some extent. By crossing this animal with the alpaca it is hoped to obtain a type that will be easily domesticated and propagated in large numbers. The wool if obtainable in quantities should have a great commercial value, for that of the alpaca is noted for its lightness and strength and its ability to take dye, while that of the vicuna is unsurpassed in softness and beauty.

THE DEVELOPMENT OF CHILDREN

If your baby girl at eighteen months yells when you want her to comply with some mere adult wish or your three-year old pushes you away and says, "No, I won't," do not be alarmed at this show of obstinacy. Periodic spells of resistance to even pleasant suggestions are part of the normal development of the normal child, according to Dr. D. M. Levy, psychiatrist, formerly with the Illinois Institute for Juvenile Research, who has made an extended investigation of resistance in children.

Babies of less than six months tend to be calm, even when just awakened or interrupted at meal time, says Dr. Levy; but, from six months on, perverseness increases until the third year, often with a minor high point of resistance at the eighteenth month, which is particularly apt to appear in the case of girls. After the third year resistance gradually decreases until the child at five years readily cooperates with an adult who knows how to make himself agreeable. Girls, on the whole, show more resistance than boys.

In the course of his work Dr. Levy examined many babies and soon found that his associates agreed with him that three-year olds showed the greatest resistance to any kind of examination, even to the "games" which compose the mental test for a youngster of that age. To check up on this general feeling, Dr. Levy devised a series of simple tests which could be given uniformly to children from six months on, to test, not mentality alone, but degree of resistance in complying with the directions given. Seated on the mother's lap, each child is tested as to its ability to grasp objects in front, above and behind the head. Placed on the floor by the examiner, the baby is next tossed a ball with instructions to catch it, and then is asked to throw the ball back to the examiner. The baby is then placed on a table by the examiner and further tests given. All the time the baby is closely observed as to its behavior, and careful notations made in writing together with the age of the baby and other data needed. The number of tests the baby refuses to perform gives the degree of resistance.

To check the results, a number of children were examined in their own nursery under favorable conditions—and the percentage of resistant babies remained the same. Personal dislike for the examiner was tested by having the mothers ask their children to perform the tasks—and the babies were still contrary. Therefore Dr. Levy concluded that gradually increasing resistance to the third year, followed by a decrease, is normal in the growth of a child's personality.

ITEMS

Tests of the Japanese vaccine for protection against rabies carried on by Dr. H. W. Schoening, of the U. S. Department of Agriculture, indicate that the serum is a valuable protection, but that its degree of success seems to depend on the strain of infective virus against which it is compelled to work. Apparently, the invisible, ultramicroscopic organism that causes madness in dogs exists in varieties as distinct as those found in larger plants and animals, for tests made upon vaccinated dogs with virus from different sources gave varying results. In one test, five out of six vaccinated dogs inoculated with rabies died of the disease; in another three out of ten, while in a third experiment none of the dogs contracted the malady. Unvaccinated animals, inoculated with the disease at the same time, as "controls" or checks, suffered more severely than those previously treated with the protective serum. One of the experiments showed a larger fatality among the vaccinated than among the unvaccinated dogs, but this was due apparently to a spoiled lot of vaccine. Dr. Schoening states that the method has already been widely used in Japan, and that among over 30,000 dogs vaccinated only one death has been reported.

Birds have a sense of taste very similar to that of human beings, but not so acute, according to the recent investigations of a German ornithologist, Bernhard Ransch. He tested canaries for their sensitiveness for sour, salty, bitter and sweet substances by giving them solutions of acetic acid, common salt, powdered aloes and cane sugar in their drinking water. The lowest limit for acetic acid, a 1½ per cent. solution which appears to us only slightly sour, was refused by the birds after one or two trials. Common salt was refused in a 5 per cent. but accepted in a 2 per cent. solution, which still appears to us as distinctly salty. The birds were less sensitive to the bitter test; while refusing a strong solution they readily took a weaker one, the bitterness of which would seem unbearable to us. This lack of sensitiveness for pronouncedly bitter substances may be explained by the fact that seed-eating birds are accustomed to many kinds of bitter seeds. The sweet taste of a 20 per cent. solution of cane sugar apparently produced a positive sense of pleasure.

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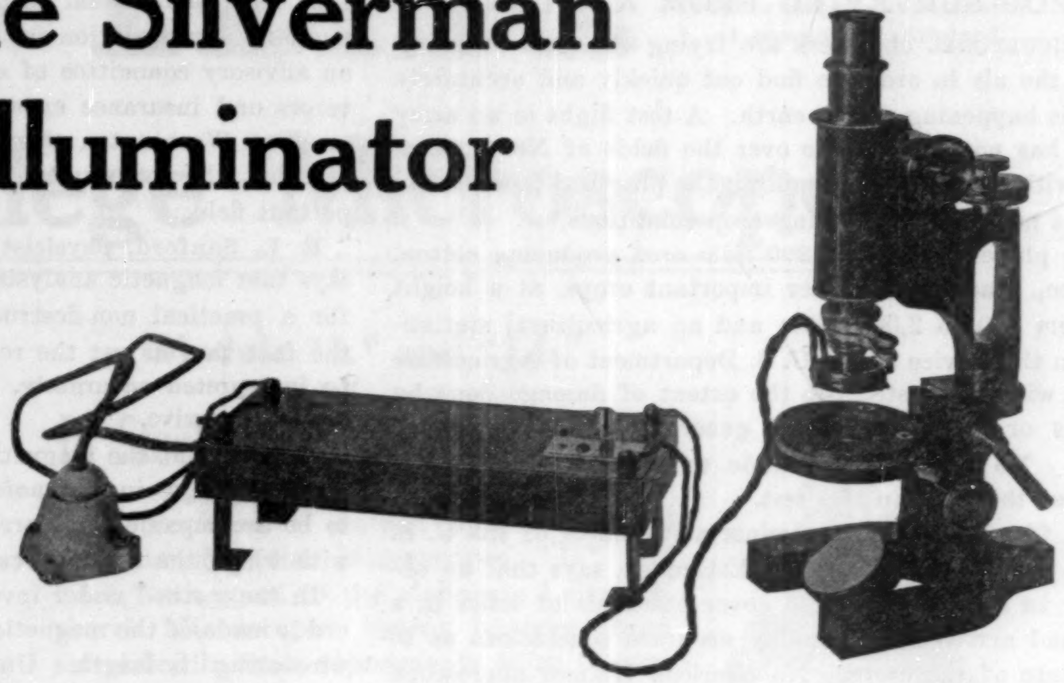

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SCIENCE NEWS

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CROP SURVEYING FROM AIRPLANES

AGRICULTURAL observers are trying the plan of going up in the air in order to find out quickly and accurately what is happening on the earth. A test flight in an army plane has now been made over the fields of North Carolina, with a view to determining the practical possibilities of this method in surveying crop conditions.

The plane flew over a 200 mile area producing cotton, tobacco, peaches and other important crops, at a height of from 500 to 2,000 feet; and an agricultural statistician in the service of the U. S. Department of Agriculture noted with unassisted eye the extent of damage done by insects or storms, and the general healthiness of the crops. No attempt was made to estimate the acreage yield of the fields in this test.

Mr. Charles E. Gage, adminstrative officer of the U. S. Office of Crop and Livestock Estimates, says that an observer in an airplane could cover hundreds of miles in a day and arrive at reasonably accurate conclusions as to the state of the crops. No Sherlock Holmes microscope is needed to show the ravages of insects, or of wind, rain or drought. A cotton field that is a dark, healthy green has obviously escaped weevil attack. Another field that is moderately infested will be of a lighter color, and a field that has fed a huge army of hungry weevils may be left entirely bare of foliage. The color of the soil shows an air observer whether land is suffering from drought or is plentifully supplied with moisture.

A quick means of reporting on the state of growing crops might prevent some disturbance of market prices due to guesses and rumors. After a big storm reports of damage are apt to be exaggerated. And sometimes there is difficulty in finding out the truth because trained crop observers may not be available or transportation may be interfered with by washouts or bad roads.

The ordinary method of finding out the condition of the crops in a state is to send out questionnaires to farmers and then to tabulate the answers received. In the case of a severe storm, special questionnaires may be quickly sent out, supplemented by reports from trained observers who travel through the region by automobile or train. By such means it takes not less than ten days to get a conservative estimate of damage, whereas an airplane observer might report on a large area within a few hours.

DETECTION OF DEFECTS IN STEEL BY MAGNETIC TESTS

STEEL girders and cables that appear to be perfect but that contain dangerous hidden flaws will no longer deceive engineers and menace public safety when one more of nature's mysteries has been fully probed.

Magnetic analysis is the method that promises so much in the way of searching out defects in steel. For two years, the U. S. Bureau of Standards has been working with this method, in the hope of making it practical and thus providing a more searching test for elevator cables than the usual visual inspection. As the congress has made no appropriation for the work for the coming year, an advisory committee of engineers, physicists, manufacturers and insurance experts interested in the tests will meet at Washington this month to hear a final report of what the government has accomplished in this important field.

R. L. Sanford, physicist at the Bureau of Standards, says that magnetic analysis meets all of the requirements for a practical non-destructive test of steel, except for the fact that as yet the results of a test can not always be interpreted accurately. The method is simple, rapid and inexpensive.

The basis of the magnetic tests, Mr. Sanford explains, is that changes in mechanical qualities of steel are found to be accompanied by corresponding changes in the ease with which the material can be magnetized.

In the method under investigation, a photographic record is made of the magnetic quality of a specimen of steel wire along its length. Uniformity of properties is indicated by a straight line record. This indicates absence of flaws. Irregularities in magnetic quality are revealed by corresponding irregularities in the record. Defects in the material cause such irregularities. The difficulty is that other causes which do not impair the strength of the steel may also, musteriously, produce an irregular record. A flaw was indicated in one bar of steel, and it was broken and the flaw found. But in several other tests similar reactions were noted, and when the bars were broken no flaws were found. The present problem, therefore, is to discover the key to the interpretation of the magnetic records.

Mr. Sanford says that when the principles of magnetic analysis are fully understood it should be possible to test a steel girder or a cable before it leaves the factory, and again when it is put in place, and whenever its safety is questioned.

The Bureau of Standards may continue the experiments in a limited way from its regular funds.

TESTS FOR INTOXICATION

"When is a man intoxicated?" is still a burning question in this sixth year of the Volstead era. Courts and police have tried all sorts of tests, from making a suspect say the alphabet backwards to having him walk a chalk line. And now comes Dr. H. L. Hollingworth, of Columbia University, who has put six college students to a two-week drinking test, and who says that the most accurate tape line for measuring intoxication is the psychological method.

Dr. Hollingworth sought to find out whether a state of intoxication could be most reliably detected by a person observing the behavior of the suspect, or by the mental state of the drinker as he himself honestly described it, or by scientific tests. The report of his work will appear in a forthcoming issue of *The Journal of Applied Psychology*.

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Neither the drinkers nor the observers who took part in the experiment were told on what days alcohol was included in the diet of the drinking students. The observers, who were present in the laboratory throughout the investigation, noted the conversation, conduct, appearance and attitude of the students. At the end of every day, each observer reported any unusual signs noted in any of the test men, or else wrote that their behavior was normal.

Each of the men under test kept a diary in which he recorded his sensations and feelings, his activities in the evening after the days tests were over, and the amount and quality of his sleep at night. Psychological tests were also made on each student daily. These tests measured their steadiness, speed and control in tapping with a pencil, ability to put a pointed instrument into something which resembled a keyhole, their clearheadedness at adding figures, and at naming colors, and other significant reactions which might be affected by intoxication.

Dr. Hollingworth reports that a comparison of the results of the three methods of detecting intoxication shows that the most accurate method is the psychological test, in which abilities of the subject are definitely determined. By a scientific test it is possible to detect the effects of relatively small doses of alcohol, doses so small that the "judgment tests" declared the subject to be normal.

ORIGIN OF THE BANANA

In a scathing denunciation of what he termed the great American banana myth, Dr. W. E. Safford, economic botanist of the U. S. Department of Agriculture, has attacked evidence recently brought forward in support of the theory that bananas originated on this hemisphere and were cultivated by prehistoric Indians.

Commenting on the discovery of fossil banana seed in coal beds of Colombia and the connection of this discovery with statements made by early writers as to the Indians' use of the fruit, he declared positively that the home of the banana was in the Malay archipelago, that it was unknown in America when Columbus reached here, and that the same writers who reported it as native to the New World demonstrated similar ignorance in regard to the potato and other plants.

Fossils show that there were horses, camels and elephants in North America ages ago, but there were none here when the Spaniards reached this hemisphere. Fossil banana seed can prove nothing in regard to American banana trees, for our bananas do not have seed. They must be propagated vegetatively from cuttings.

Columbus and his followers listed the plants they encountered, but made no mention of the banana. Bananas were introduced into the West Indies from the Canary Islands by Padre Tomas de Berlangas in 1516. They were also carried to Pacific islands by early migrants; but their native home was in the Malay archipelago.

The persistence of the myth of the American origin, according to Dr. Safford, was due to the great Humboldt, who evidently was not himself a botanist, and accepted the statements of Garcillaso de la Vega, a descendant of the Incas, who claimed in the early sixteenth century that bananas were a staple food of South American Indians in pre-Columbian times. This man, Dr. Safford said, was ignorant of the agriculture he pretended to describe. Most of his information was second-hand and his exaggerated and unreliable statements lack confirmation. Humboldt also accepted statements that the Irish potato was found in Virginia by early colonists when it has been definitely established that it was a native of Peru and was unknown in North America before the coming of the white man.

ANCESTRY OF THE REPTILES

A missing link in the prehistoric past of the reptiles has been brought to the attention of American scientists by Dr. Peter B. Sushkin, of the Russian Academy of Sciences, who is now examining specimens at leading museums in the United States.

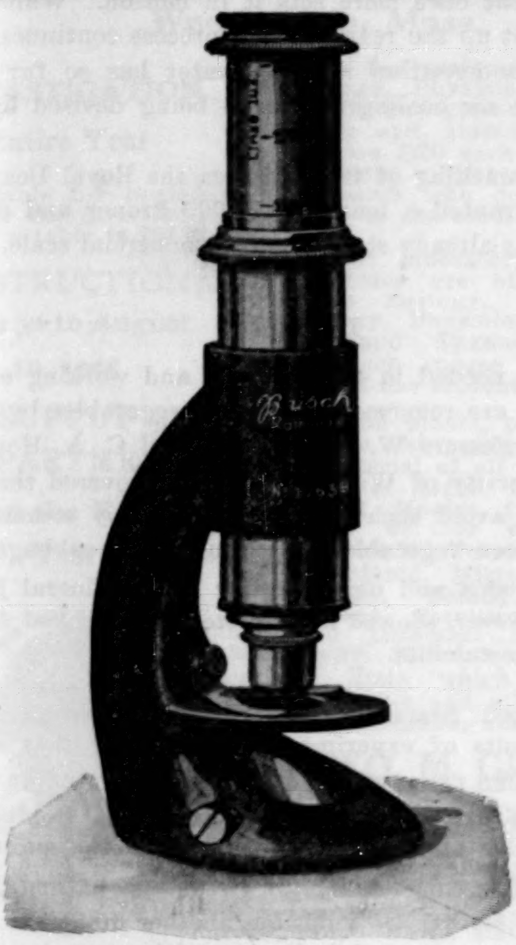
The prevailing theory is that the family tree of the reptiles can be traced back through the amphibians, which are at home both on the land and in the sea, and thence back to fish-like ancestors. But the amphibians so far found do not fit into this diagram. All amphibians known are in some respects more advanced than reptiles, and so can not be considered their ancestors. I find such evidence in the Russian material, and nothing contrary to the theory is shown in the material which I have seen in museums of the United States.

The evidence indicates that amphibians so far known represent only a side branch of development. Dr. Sushkin states that these arguments are based on the relations between the ossicles, which are small bones of the ear, and the quadrate, a bone supporting the under jaw, and on the structure of these bones. In the fish and in the principal reptiles, the bone which corresponds to the ossicle is directly connected with the quadrate. In the known amphibians, the connection has already been broken, indicating that they had progressed to an advanced stage.

The amphibians which the Russian academist has been studying were somewhat like the frogs of to-day, except that they were much larger, some being ten or fifteen feet long. They hatched their eggs under water and the young lived and breathed under water until lungs formed in their bodies, after which they could breathe only in the air. Reptiles, even those that live in water, are altogether air breathing creatures.

The prehistoric amphibians belong to the Permian age, which geologists place 25 or 30 million years ago in the earth's history. They are thus older than the oldest mammals so far discovered, as the earliest mammals finds belong to the Triassic period, which was about 20 million years ago. The earliest man whose bones have been found, *Pithecanthropus erectus,* dates back only a million years.

Dr. Sushkin says that there are many gaps in the past history of the earth's creatures, but wonderful progress has been made considering that most of the paleontological research has been done in the past forty years, and only a small part of the earth's surface has been scratched.



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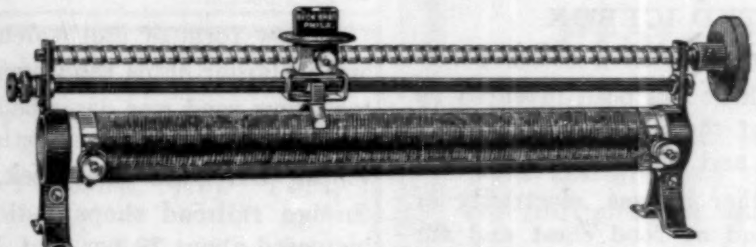

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THE ORIGIN OF THE MOON

THE earth is the parent of the moon in more than a poetic sense, in the opinion of Dr. R. H. Rastall, lecturer in economic geology at the University of Cambridge, who recently announced a theory that our satellite is made of material that was once part of the earth's crust.

Dr. Rastall's theory, however, differs from that of Sir George Darwin and others who have previously made similar suggestions, for he thinks that a layer of the earth's crust, about 41 miles thick, and covering about two thirds of its total area was peeled off by the attraction of the sun. This tidal action of the sun was effective while the crust was still in a plastic state, and the moon's own gravitational attraction caused it to roll up into a ball of the form that we now see in the sky. The crustal area left on earth formed the continents.

This theory also accounts for the fact that while, according to generally accepted ideas, masses of lighter density such as make up the earthly continents should cover the entire surface of the globe, they actually cover only about a third, the missing two thirds consisting of the moon. Measurements of the moon's density by its effect on the earth show that it is about three and a half times as heavy as an equal volume of water. This is more dense than the average for the continental land masses, but Dr. Rastall assumes that at the time of the disruption, some of the heavier underlying material was also torn away.

The new theory also fits in with the ideas recently set forth by a German geologist, Professor Alfred Wegener, who believes the American continent was originally united with Europe and Africa, and that it floated away to its present place. This would not have been possible so long as the entire earth was covered with such a crust, but after the moon had been torn away, it was possible for the continents to separate from their long embrace.

A HEAT-OPERATED ICEBOX

AN artificial icebox that operates like a coffee percolator and generates cold from heat has been invented by two young Swedish engineers of the Stockholm Institute of Technology, Carl Munters and Baltzar von Platen. When heated at one point, either by gas, electricity or kerosene, it cools the usual kind of food chest and for ordinary household purposes needs to be run only a few hours a day. When operated with gas at the Stockholm prices it produces the equivalent effect of eight pounds of ice at the cost of one cent, and in view of the mild winter and the consequent shortage of natural ice facing the country, the new invention comes most opportunely.

The construction of the new ice chest is extremely simple. It has no movable, mechanical parts, no pistons, fans, pumps, ventilators, or any gears to get out of order. The action is initiated by heat which sets an ammonia solution in motion in a small boiler. The ammonia then passes through condensation tubes and while trickling down a generator mixes with hydrogen and by thus evaporating absorbs enough heat to cool the food in the refrigerator. In a third cylinder, called the "absorber," the ammonia is washed free from the hydrogen and then percolates down through a set of tubes into the boiler again, where the heat once more sets it in motion. While this action is kept up the refrigeration process continues. To effect the condensation running water has so far been used, but an air cooling system is being devised by the inventors.

For the launching of the new idea the Royal Board of Trade has granted a loan of 300,000 kroner and manufacturing has already started on a commercial scale.

ITEMS

MINERALS needed in the building and working of the human body are removed from many vegetables by cooking, and Professors W. H. Peterson and C. A. Hoppert, of the University of Wisconsin, have discovered that the best way to avoid such losses is to cook by steam. In tests of sixteen vegetables they found that cabbage, celery, beet greens and onions suffer great mineral losses. Spinach, however, showed a complete and unlooked for retention of its calcium.

THE United States Public Health Service has announced results of experiments which prove that severe cases of human pellagra can be either prevented or cured by means of dried yeast. Surgeons Joseph Goldberger, G. A. Wheeler and W. F. Tanner, after the successful treatment of twenty-five out of twenty-six patients, were led to this discovery by following another disease in dogs. Black tongue, a bacterial disease with somewhat similar effects on the skin as are produced in severe cases of pellagra, also a bacterial infection, was produced experimentally in dogs. Then the dried yeast was given. The cures were so satisfactory in the cases of the dog disease that the Public Health Service surgeons tried the yeast treatment on pellagra patients. As early as the second or third day after the treatment beneficial effects were noted.

A NEW form of tool which cuts metal at higher speeds and in larger chips than is practicable with the standard tools now used was described to the American Society of Mechanical Engineers meeting at Milwaukee by its inventor, Dr. Hans Klopstock, of Berlin. Tests made in foreign railroad shops indicate that production can be increased about 30 per cent. by means of the new tool.

HOW large power plants can save thousands of dollars in summer coal bills by tapping lower levels of lake water was the subject of a paper read before the American Society of Mechanical Engineers recently meeting in Milwaukee by Professor A. G. Christie, of the Johns Hopkins University. By placing intakes for cooling water for use in condensing steam so that they would reach the cold bottom layers of northern lakes, Professor Christie showed that water 10 to 20 degrees colder could be obtained. With this colder cooling water additional vacuum could be obtained in the condenser and the consumption of steam could be decreased. He estimated that the decrease in steam consumption due to increase of vacuum would result in a saving of $36,956 in four and one half months' operation of a 100,000 kw. plant.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE ROCKS AND HILLS OF DAYTON TESTIFY FOR EVOLUTION

THE very hills themselves testify for evolution. The little town of Dayton, to be the scene of the now famous trial of J. T. Scopes, for violation of the Tennessee anti-evolution law, could not be better placed geologically as the site for such a test to determine whether natural law, made by God, or legal law, made by man, shall prevail.

The very ground the courthouse is placed upon, the rocks of the landscape with the embalmed life of ages ago will all be irrefutable witnesses for the defense if men will but use their eyes and their brains.

West of the little country town of Dayton is Walden's Ridge—named for an event in a previous struggle that concerned the freedom of the body of man. It is appropriate that this ridge is composed of the youngest and most recent rocks of the region thereabout and that below it, exposed by the wear and wash and the uneasiness of the earth for millenniums, there is layer upon layer of rocks each representing different and progressively older deposits. The ridge itself is composed of sandstone interleaved with layers of coal, the natural source of one of the commercial products of Dayton. This is the record of the rocks that testify to-day that there was a time when trees looked like gigantic ferns and had spores instead of seeds. Look at a piece of coal under the microscope and those spores can be seen and identified to-day.

Close by the coal seams are layers of iron ore made by the accumulative activities of millions of bacteria millions of years ago. And lower down in the hills and earlier in age are strata of limestone, useful to man in utilizing the iron. These many layers of rocks were made by nature in the geological era now called by scientists the Carboniferous on account of its coal. Below them there are Devonian and Silurian rocks and earth upon which the town of Dayton itself rests and out of which spring the strawberries and peaches, the principal products of the region.

In all these rock layers evidence of prehistoric life can be found. There are spores of the trees that made the coal, calcified remains of trilobites, ancestors of the modern cockroach, fossil tree trunks and other animal and vegetable remains of a time that antedated man by millions of years.

Is it any wonder that it was Dr. G. W. Rappleyea, superintendent of the Cumberland Iron and Coal Co., who instigated the anti-evolution test case against the young Dayton high-school science teacher, Scopes? For in his work of finding iron and coal, he has learned the reliability of the record of the rocks.

Scopes, too, knows how to read the story chronicled in limestone, shale, iron and coal. And it makes him more determined that he shall not be prevented from teaching his eager young pupils the most basic, most interesting and most fundamental facts of nature.

Perhaps, if the question of the reality of evolution arises in the evolution trial set for July 10, it would be well for the judge to have the jury take a walk among the hills and see for itself just how, at one stage in the world's history, Nature slowly and purposefully conducted the building of the earth.

THE ORIGIN OF THE VERTEBRATES

THE real missing link in the evolutionary chain according to Professor William Patten, who teaches the freshman course in evolution at Dartmouth, is not the immediate progenitor of man, but a much more remote ancestor, which connected the fishes with the earlier invertebrate forms. Professor Patten has long held that the secret of this problem would be found in the oldest fish-like animals known, the Ostracoderms, who made their appearance in the early Paleozoic, long before the first true fishes came into existence. The last representatives of this class died out in the Carboniferous era and their fossil remains are rare and fragmentary.

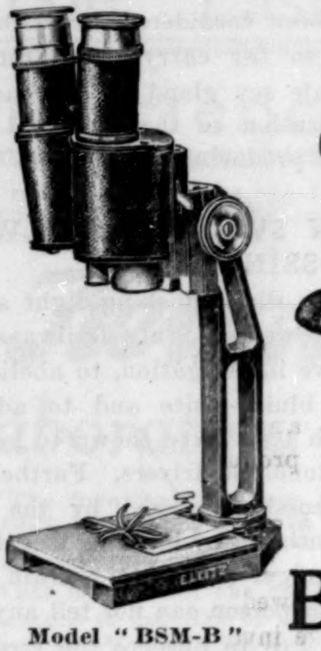
But Professor Patten has heard of a new find of these fossils on the northwest corner of Spitzbergen, and he is starting as soon as possible to explore the locality for this new evidence of evolution. From the northern point of Norway he will proceed to Spitzbergen, five hundred miles north, and then charter a motor boat to convey him along the coast of the islands.

Professor Patten's motive in undertaking this voyage of exploration may be given in his own words:

''To the biologist, the real 'missing link' in animal evolution is not between man and apes, but between vertebrates and invertebrates. For the genesis of practically every great system of organs in man can be traced in various ways without serious question to corresponding organs in the fishes. But there the genetic trail ends.

''Thus there is the greatest difference of opinion as to what class of invertebrates gave rise to the fishes and through them to the higher vertebrates. Many biologists now regard this problem as insoluble. I am not of that opinion. I have worked on various aspects of it for nearly forty years and am convinced that I have found essentially the correct solution. The recent finds in Spitzbergen, judging from the as yet brief preliminary accounts, confirm my predictions in a most striking manner.

''This problem has great practical as well as theoretic possibilities. Its solution would more than double our present perspective of the course and manner of animal evolution. Moreover, three of the oldest and most important organs of man from a medical standpoint are the pineal gland, the pituitary organ and the thyroid. They apparently have essentially the same structure and functions in all the back-boned animals from man down to the fishes. If we can prove that the ancestors of the Ostracoderms and fishes were spider-like animals, as I



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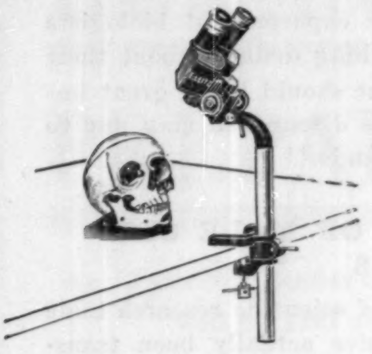

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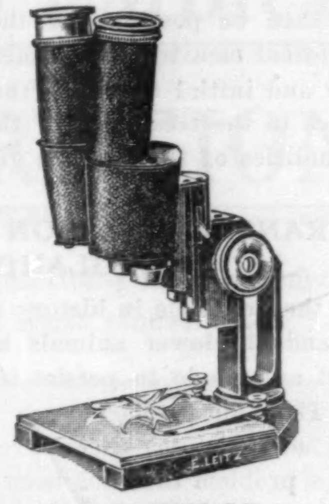

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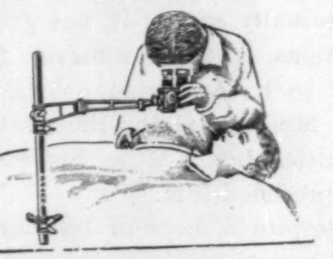

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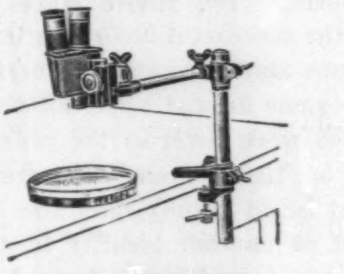

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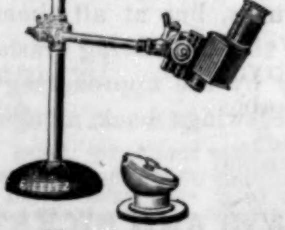

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believe we can, the homologues of these mysterious organs can be readily identified in living invertebrates, such as modern scorpions and the horseshoe crab. It would then be possible for the experimental biologists and medical men to learn something definite about their history and initial functions that should be of great importance in the treatment of the diseases in man due to abnormalities of the ductless glands.''

TRANSPLANTATION OF MALE SEX GLANDS

For the first time in history of scientific research male sex glands in lower animals have actually been transplanted and made to persist in perfectly normal condition. The announcement was made to-day at the University of Chicago where Professor C. R. Moore has solved a problem that has been troubling biologists since 1796.

Dr. Moore has developed a technic that has enabled him to transfer male sex glands from one laboratory animal, such as a rat or rabbit, to another of the same species but of a different age. This transfer tissue has developed a blood supply from a set of blood vessels that does not normally supply it, has grown for months under new conditions, and on removal for examination has been found to have carried on its normal function.

Dr. Moore explains the work as follows, revealing the difficulties involved in his experiments and those that have preceded him.

''Despite a more or less intensive study of sex gland transplantation for many years past by biologists all over the world,'' Dr. Moore states, ''the conditions underlying the successful incorporation of such tissues removed from one animal to another, or from one place to another in the same animal have not been well understood.

''The work involves the separation of a very delicate piece of tissue from its normal environment and its normal blood supply, and the transfer of it to another animal or another locality in the same animal. Unless the tissue meets conditions sufficiently favorable to enable it to establish a new blood supply it will very soon die and be removed by the protecting mechanisms of the body as any foreign body might be so disposed.

''The female sex gland has been transplanted with considerable success for many years, and in many cases retained its normal condition and function, but the male sex gland of mammals has been found more difficult to work with on account of its very sensitive nature. Until recently it has never been transplanted, even from one place to another in the same mammalian organisms with anything like persistence in its normal conditions.

''With the knowledge gained from many different lines of investigation during the last seven years, facts have been uncovered and so utilized that I am now able to announce the persistence of portions of the male sex gland of mammals in a perfectly normal condition.

''The male gland transplantation in mammals has been studied by many European workers and persistence of some structures of it have been obtained for the past twenty-five years. The tissue persisting, however, has never been found in a normal condition. Structurally it has been altered very considerably and has never been found to carry on its normal function of producing mature sex cells. It has been considered impossible, up to the present time, to so far carry over from one animal to another the male sex gland of the mammal and to obtain its incorporation so that it could carry on its normal function of producing germ cells.''

COLOR SIGNALS IN SWEDISH RAILWAY CROSSINGS

To aid the color blind in distinguishing light signals at railroad crossings, the Swedish State Railways have decided, after an exhaustive investigation, to abolish the green light in favor of bluish-white and to adopt a special shade of red, which tests have shown to be most easily recognized by all automobile drivers. Furthermore, the lights installed at crossings owned by the state, will be additionally differentiated by blinking at different speeds when there is no danger and when a train is approaching, so that even if a person can not tell any color from another, he can not fail to observe the frequency with which the light flickers.

The state railways' eye specialist, Dr. C. G. Bostrom, has conducted the experiments and has found that between five and six per cent. of all males are colorblind and that, since practically every one in Sweden wants to drive a car, it would be unjust to deprive these men of the privilege, as seriously proposed in the Riksdag. At the same time many accidents have been found to be due to the inability of drivers to tell the green lights from the red, so that from July 1 this year the new double precaution will be adopted.

Another device to safeguard railroad crossings has been invented by a Swedish engineer, A. Westfelt, and tests have been made at certain crossings on the state lines. It consists of a bar that swings out seven feet above the ground whenever a train approaches and a row of short chains that strike any car trying to pass under without injuring it. Being placed about eighty feet from the crossing, the bar gives the driver warning in time to stop before reaching the tracks, but at all times it remains high enough in the air to escape being crashed into. It is operated automatically by the approaching trains, and when danger is over it swings back alongside the roadway.

ULTRA-VIOLET RAYS AND RICKETS

That such fats as olive oil and lard may be activated by exposure to ultra-violet rays and used as a substitute for cod liver oil in the treatment of rickets is shown by experiments about to be reported by the Department of Agricultural Chemistry of the University of Wisconsin in a forthcoming issue of *The Journal of Biological Chemistry*.

Until recent years, rickets has been a scourge among babies. Only within the past few years has science demonstrated that rickets is due to a deficiency of calcium in the bones and that the oil from the liver of the codfish will prevent and even cure the disease.

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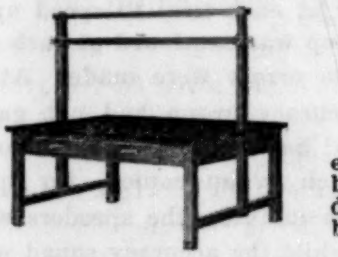

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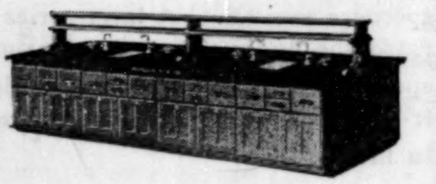

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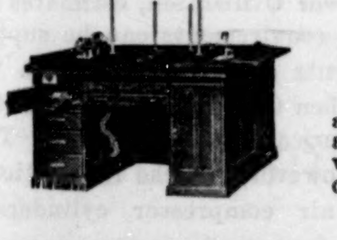

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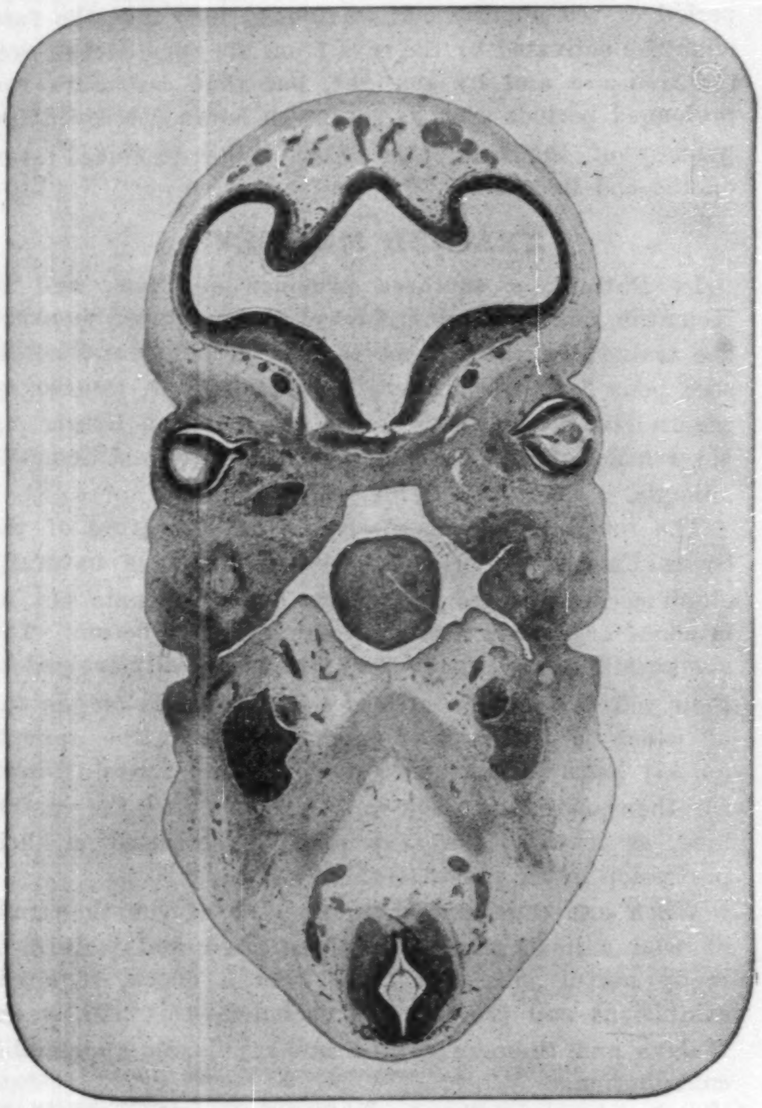

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After exposure to the rays these fats were fed to a group of experimental rats in which rickets had been produced and the activated olive oil and lard were found to have the same beneficial results that followed the administration of cod liver oil. Not only did the weight of the rats increase, but an analysis of the bones showed an increase in the calcium content.

Some of the activated olive oil that had been stored in a stoppered bottle showed no change in potency after a period of ten months. It was found also that the fats might be activated by the rays from the open carbon arc, the iron arc and by sunlight, but that expoosure for prolonged periods such as seventeen hours destroyed the potency of the fats, this effect being produced even on the cod liver oil.

TRAINED MONKEYS

In Pattani, a southern province of Siam, and in Kelantan, one of the unfederated Malay States, monkeys are trained by the natives to pick coconuts and edible seed pods for their masters, according to D. Bourke, of the Indian Forest Service, who has made an interesting observation of a new commercial use of trained domestic animals.

The romantic notion—derived from literature of the Swiss Family Robinson type—that monkeys naturally climb coconut palms and throw down the nuts out of mischief or from a desire to oblige is pure fiction. The monkeys must be caught young and carefully trained to their jobs by attaching them to a long pole on the top of which is fastened a bunch of fruit. The animals quickly learn to run up to the fruit and throw it down for their own food. Having once mastered the central idea, as it were, they can then be perfected in their profession in the palm trees.

When one considers how very few of the thousands of wild animals man has domesticated and trained to really useful jobs—not more than a dozen, if circus exhibitions and the like are excluded—this use by the Malays and Siamese of the monkey is an appreciable contribution.

Everywhere in Siam and Malaya one sees monkeys kept as pets, but Mr. Bourke was struck by the extraordinary number that he saw in Pattani. Every hut had one or two chained in the doorway, and the natives walked about followed by monkeys attached to long coir ropes. The explanation for this unusual fondness for the animals was the above utilitarian one.

Only the larger monkeys are successful with the coconuts. It requires considerable effort and frequently the use of teeth as well as hands to detach the nuts. But the smaller monkeys can readily manage the pods which grow in small clusters on the ends of the branches of the sataw tree, and which provide the natives with an important food item. The seeds resemble a broad bean, and are eaten as a vegetable, both raw and cooked. It is said that a well-trained monkey can pick as many pods in a day as a man, thus enabling his fortunate owner to earn a full day's wages with a minimum amount of effort.

ITEMS

Sponges are the bee hives of the sea. This curious discovery has been reported to the U. S. Bureau of Fisheries by Dr. Charles J. Fish, of the scientific staff of the New York Zoological Society's steamer *Arcturus*, cruising in tropical waters. The "bees" which Dr. Fish found inhabiting the canals of sponges were whole colonies of the tiny snapping shrimp, Alpheus. These gregarious shrimps, he discovered, swim freely about but always return to the individual sponge which is their hive-like home. Numerous other forms were also found to use these subway passages as a haven of refuge at the approach of danger. One sponge-hive with its homing shrimps was secured and placed in an aquarium aboard ship where the colony continued to flourish. This discovery makes known another of Nature's queer partnerships; for the sponge which the shrimps use as a home is itself a marine animal, although it spends its adult life fixed to the rocks in one place, like a plant and the canals which shelter the shrimps are the many mouths through which the sponge gets its food.

Development of accuracy is more important than speed in learning to do certain mechanical operations, according to Dr. Garry Cleveland Myers, of Cleveland, Ohio, who will report a new series of experiments in a forthcoming issue of *The Journal of Personnel Research*. Typewriting was done by two squads of seven girls each, practising three minutes a day for thirty-six days. One group was instructed to work for speed and were reminded by their instructor at each trial to speed up all they could. The other group was cautioned at each trial to take great care that no errors were made. At the end of the period the accuracy group had not gained much over the speed group; but later, after four months without practice, when each group copied, for speed, unfamiliar material for ten minutes, the speeders wrote an average of 383 words, while the accuracy squad wrote an average of 451 words. The average of the accuracy workers was 1.2 words wrong per hundred; that of the speeders was 2.2. A later series of experiments corroborated the finding that if attention was directed solely to speed, accuracy tended to diminish. On the other hand, if attention was directed solely to accuracy, speed tended to increase.

Petroleum oil may be supplanted as a lubricant in most German industries by oils produced from lignite and coal tar. Dr. Baum, of the Commission on Mining Engineering, Heat and Power Utilization, estimates that 80 per cent. of Germany's requirements can be supplied at less cost by improvements of lubricants which were produced during the war when Germany was cut off from sources of Russian and American lubricating oils. These tar oils are not suitable, however, for the lubrication of steam engine cylinders, air compressor cylinders or turbines.

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SCIENCE NEWS

Science Service, Washington, D. C.

MASURIUM AND RHENIUM

USE of spectra obtained by passing a beam of X-rays through concentrated solutions of rare minerals has enabled Dr. Walter Noddack, of the University of Berlin, assisted by Otto Berg and Ida Tacke, to discover the missing chemical elements, numbers 43 and 75, in the group with manganese in the periodic table. Traces of them have been detected in the concentrated solutions of platinum ores and of the minerals gadolinite and columbite, and it is estimated that they form a billionth of the earth's crust. Dr. Noddack has named them masurium and rhenium after the territories lost by Germany as a result of the peace treaty, the Masurian region of East Prussia on the east and the Rhine provinces on the west.

The new elements, masurium and rhenium, discovered by Dr. Walter Noddack, in Berlin, were brought to light as a result of a law discovered by Henry G. J. Moseley, a young British scientist who lost his life in Gallipoli during the war. When a beam of X-rays is reflected by a crystal or powdered crystals it is spread out into a band, after the manner of a beam of light passing through a glass prism. If this band is allowed to fall on a photographic plate, a series of light and dark lines is obtained, which is called the X-ray spectrum. The X-rays have very short wave lengths and therefore come at the extreme end of the spectrum, beyond the ultra-violet waves.

After a study of the X-ray spectra of many elements, Moseley formulated a law which now bears his name, by means of which, if the atomic number of an element, or its position in the periodic table, is known, the character of its X-ray spectrum may be obtained. A few vacancies still exist in the 92 spaces of the table, but the characteristic spectra of the unknown elements can be calculated in advance, and when a substance is found to give this spectrum, there is no doubt of its identity.

Similar methods were used in 1922 by G. Hevesy and D. Coster at the Institute for Theoretical Physics at Copenhagen, to discover the missing element number 72, which was named Hafnium, after the Latin name for Copenhagen.

With the discovery of the new elements, there are only three vacant places left in the periodic system, which have the numbers 61, 85 and 87. These, like masurium and rhenium, which are numbers 43 and 75, are odd numbers, as it is a curious fact, pointed out by Professor Harkins, of the University of Chicago, that in the case of elements of high atomic weights, those of even number are more common.

Noddack was trained under Nernst, the famous physical chemist of the University of Berlin.

CRYSTALS OF VITAMIN

VITAMIN "C," the preventive of scurvy, has been obtained for the first time concentrated into crystalline form, by N. Bezssonoff, a biochemist. M. Bezssonoff obtained his product by the concentration of a large quantity of the juice of cabbages, which vegetables have long been recognized as effective in the prevention of scurvy. After the final treatment he had a quantity of colorless, needle-shaped crystals that had the same effect in the prevention and cure of the disease as is shown by fresh fruits and vegetables, even when given in the minutest amounts. Scurvy could be prevented in rats, his test animals, by daily doses as small as two milligrams, or less than one one-hundred-thousandth of an ounce. Chemical analysis of the crystals showed them to belong to the hydrocarbon group of organic substances; the compound has been given the technical name of "phenolic anthracene quinone."

Scurvy, the disease for which vitamin "C" is the preventive, used to be a terrible scourge in the old days of sailing ships, when men went on long voyages without adequate supplies of fresh vegetables. It manifested itself in general weakness and debility, distressing skin troubles and the loosening and dropping out of the teeth. Its cure was discovered before its cause was discovered, simply because its cause consisted only in the absence of its cure. Its cause, as is now well known, is the absence of a certain definite food factor, called vitamin "C," and the supplying of vegetables and fruits that contain the vitamin prevents its development and also stops it where it has started. The isolation of this vitamin in pure form as crystals in M. Bezssonoff's contribution to the triumph of science over this disease.

VEGETABLE DIET AND THE LENGTH OF LIFE

THE vegetarians' idea that meat eaters are destined for an early grave receives little support from conclusions of Professor James R. Slonaker, Stanford University physiologist. After experimenting with rats for eight years, Professor Slonaker applies his findings to humans and declares that meat is essential if the human race is to continue.

White rats, under Professor Slonaker's care, reacted very definitely to vegetable and protein diets. The restricted, or vegetable, diet, caused a shortening of the span of life—33 per cent. in the males, and 40 per cent. in the females. Soon after meat was withdrawn from their diet, males lost 35 per cent. of their weight, females from 25 to 28 per cent. By the third generation, power of reproduction was wholly lost in the non-meat-eaters.

"This indicates," said Professor Slonaker, "that there is something lacking in vegetable food which is furnished by the supplementary animal protein. This may be due to additional protein in a form more readily utilized by the animal, or the particular protein may act as a stimulus, causing all cells of the body to become more active and thus making possible a greater and more complete use of the vegetable foods consumed."

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Professor Slonaker claims that if man were subjected to the same treatment accorded his rats for a lifetime, results would generally be the same.

RELATIVITY IN THE LIGHT OF EXPERIMENTS BY THE ETHER DRIFT

EXPERIMENTS performed by Dr. Dayton C. Miller, of the Case School of Applied Science, Cleveland, at the Mount Wilson Observatory, California, do not disprove the theory of relativity, as many astronomers have claimed, says Dr. A. S. Eddington, professor of astronomy at the University of Cambridge, England, in a letter to *Nature*. Referring to the article written for *Science Service* by Dr. Ludwik Silberstein, mathematical physicist of the Eastman Research Laboratory at Rochester, following Professor Miller's presentation of his results at the recent meeting of the National Academy of Sciences at Washington, Professor Eddington says, "The brief messages in regard to Professor Miller's experiment have aroused much interest and bewilderment; it is therefore of great value to have Dr. Silberstein's authoritative account."

Professor Miller's experiment was a repetition of one originally performed by Dr. Albert A. Michelson, now at the University of Chicago, and Professor Edward Morley, by which a beam of light was divided into two parts and reflected back and forth in directions at right angles to each other. They were then reunited and a series of light and dark bands resulted. From the position of these bands the physicist can tell which beam takes the longest time to return. When first performed, in the basement of the Case School, Cleveland, in 1887, no effect was obtained, but when he repeated it last summer at Mt. Wilson, Professor Miller obtained a marked effect.

Professor Eddington disagrees with Dr. Silberstein's interpretation of the new experiment as indicating that the ether, by which light is supposed to be transmitted, is gliding over the earth with a speed which varies from about zero at sea level to about six miles per second at the altitude of the Mt. Wilson Observatory. "There is thus," says the Cambridge astronomer, "a rapid rotational motion of this part of the ether."

In order to account for the astronomical facts, however, this motion must be the same at all levels. Just as a boat set to steer a straight course would be turned to one side if it entered a current of water moving at a different speed, a ray of light which is vertical at the level of Mt. Wilson would be inclined a small amount at sea level, and the direction in which it is inclined would vary according to the time of day or night. The amount of inclination would be about 7 seconds of arc, but astronomical observations capable of detecting a much smaller deflection have never revealed any such discordance of positions of stars as seen from sea level and mountain observatories.

"The Michelson-Morley experiment," Professor Eddington concludes, "was originally performed because it was thought—mistakenly, as we now realize—that it would measure absolute ether drift. In the new application, it is invading a field in which the facts have long been established by delicate observations and it is difficult to regard it as a serious competitor."

THE ASTRONOMICAL ALMANAC FOR 1927

ASTRONOMERS will now be able to make plans in detail for their activities during 1927, for the "American Ephemeris and Nautical Almanac" for that year has just been published by the Government Printing Office and the first copies have been received at the Naval Observatory. This book, containing over 800 pages, which is published annually, and is as indispensable in observatories as Dun's or Bradstreet's list of mercantile ratings in business houses, is prepared annually under the direction of Dr. W. S. Eichelberger with the assistance of sixteen other astronomers.

In it is found complete information concerning all important astronomical events scheduled to occur during the year. This includes spectacular events like eclipses, of which two of the sun are on the program for 1927, and occultations, when the moon passes before a star or planet. Matters of less popular interest, but of importance to the astronomer, such as daily positions of the sun, moon and planets, variations in the positions of stars, at different times of the year, tables for converting "sidereal," or astronomical, time to that in ordinary use, and positions of the moons of Jupiter and Saturn occupy a large part of the book.

Already, according to Dr. Eichelberger, work is well under way on the Ephemeris for 1928, which will be published next spring, while that for 1929 has been started. Not all the work is done by the American office, however. Similar publications are issued by the English, French, German, Spanish and Italian governments, and under a cooperative arrangement made in 1912 the work of each office is available to the rest. The work is divided, but the American office carefully checks that received from other countries to avoid errors.

THE EVOLUTION OF APES

THE bodies of apes and monkeys are more evolved, that is, more highly specialized physically in many respects than the human body. Man has specialized on the production of a large and useful brain, and has allowed his body to remain in a relatively primitive state. These ideas, startlingly opposed to current notions, are put forth by Dr. Adolph H. Schultz, of the Carnegie Institution, in the forthcoming issue of the *Journal* of the Washington Academy of Sciences.

In his review of the many resemblances between man and the apes, Dr. Schultz has made use of features that develop both before birth and during growth to adult stature. One of the outstanding examples of greater physical specialization in the lower animals is the disappearance of the thumb in certain species of monkeys, which goes along with the much-noticed lengthening of the arms in the direction of special adaptation for climbing. All that is left of the thumb in these monkeys is a mere stump or rudiment, though occasionally a specimen appears in which a longer thumb is evident.

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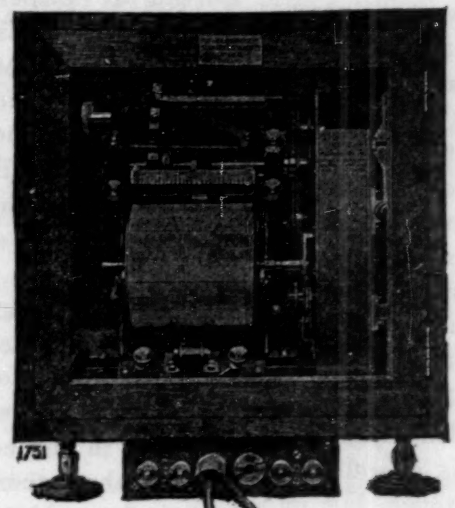

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Even in the matter of getting rid of a tail, certain of the apes have out-evolved man, for they have less of a rudimentary tail than man himself. And during the time before birth, man's tail is well developed externally, reaching a length nearly one fifth that of his body. Sometimes the external tail in man persists after birth. A record case of the kind is cited by Professor Schultz, who shows a picture of a twelve-year-old boy from Indo-China with a tail nine inches long.

In the position of the eyes, also, the monkeys have gone farther from the primitive animal state than man has. In the lower animals the eyes are far apart, being indeed in many forms on quite opposite sides of the head. In the pre-natal development of both man and monkeys the eyes start far apart, and become relatively closer together as growth proceeds. But in man they remain noticeably farther apart than they do in many of the simians. In the development of the outer ear, however, man occupies an intermediate position; for while the ear of the chimpanzee is enormous compared with that of man, the gorilla's ear is just about of human size, and the ear of the orang is considerably smaller.

Another little-known feature described by Professor Schultz is the so-called carpal hillock, a little fleshy projection on the wrist, crowned with a few long hairs or bristles. In some of the lower animals this is well developed and seems to serve as an organ of touch, but in most monkeys it is absent. However, in the fetuses of monkeys it is present, hairs and all, and once in a while it crops up in an adult monkey. In the human being before birth the same hillock appears and later vanishes, but it never has the hairs.

Professor Schultz sums up his paper as follows: "The outstanding conclusions from these embryological studies can be summarized by stating that the many striking resemblances between man, ape and monkey in early development, and their frequently closely corresponding growth changes can only be understood by assuming one common origin for all primates, including man, from which they inherited the tendency for the same ontogenetic processes which have become modified in many instances through a variety of later specializations. Furthermore, there exists ample evidence for the conclusion that the human body is in many points less specialized and hence has remained in some parts phylogenetically, as well as ontogenetically, more original and 'primitive' than have various other primates."

ITEMS

"A PIECE of linen sent to our research department recently from London, though 6,000 years old, was found to be as perfect structurally as the linens we are making to-day." This was the statement made by W. H. Webb, the chairman of the Irish Linen Society, recently, at Oxford, and he explained it on the grounds that germs of decay would have nothing to do with linen. Similarly, he said, the windings found in 1881 on the mummy of Rameses II, who oppressed the Israelites in the time of Moses, were still perfect. The supply of flax from Russia, he pointed out, had collapsed, but the Empire Flax Growing Association had secured samples of the world's best seeds and after four years of breeding experiments the best plants continued true to type. They would secure shortly a greatly increased length of fiber and by improved machinery in harvesting the heavy charges on linen manufacture would probably be capable of reduction.

FISH may die from a cold bath, according to a report made by Professor Frank Smith, of the department of zoology, of the University of Illinois, to the U. S. Bureau of Fisheries. Professor Smith conducted his studies at Douglas Lake, a small body of water in the northern part of Michigan. There are a number of deep places in this lake, where the water does not circulate, and in consequence it becomes much colder than the layers of water immediately above, so that the thermometer will show a drop of several degrees in two or three feet. This condition is frequently encountered in deep, quiet lakes everywhere. Fish of several species, lowered to varying depths in wire cages, remained alive if kept above the cold depths, but died if they were left in the region of low temperature. Chemical analyses of the water showed that there was much less oxygen dissolved in the cold water than in the warmer layers, and also that other chemical conditions at the lower level were unfavorable for the support of life.

A Washington ornithologist, Dr. B. H. Swales, of the U. S. National Museum, first discovered them in a large rainwater pool on a new golf links now under construction. Many bird-lovers and naturalists have since visited the camp of the feathered tourists. The birds were all waders of the shallow shore waters. One species, the white rumped sandpiper, was especially noteworthy because this bird seldom appears in the eastern United States, but makes the first stage of its 8,000 mile flight from northern Canada to Argentina down the Mississippi Valley. An even rarer species was the stilt sandpiper, which has been seen in Washington only twice since the city was founded. The farthest-flying visitor was the black-bellied plover, which stayed three or four days. The other bird species represented were the semi-palmated sandpiper, semi-palmated plover, greater and lesser yellow-legs and the least sandpiper.

ONCE numerous colonies of gulls, terns and herons on the shores of Massachusetts are in danger of being wiped out. Various influences of civilization disturbed the well-being of the colonies to begin with, and now skunks, stray cats and human marauders are threatening the remainder. Even ants are adding to the troubles of the birds, for in some cases they have been found attacking and devouring the young as soon as they were hatched from the egg. The state is unable to give sufficient protection to the birds, and the Federation of the Bird Clubs of New England is undertaking to supplement official action. They are endeavoring to raise sufficient funds to provide the needed extra wardens and other protection before the beginning of another breeding season.

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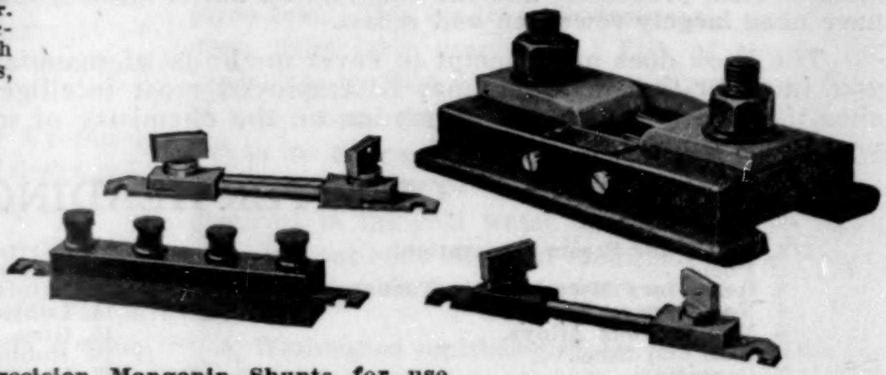

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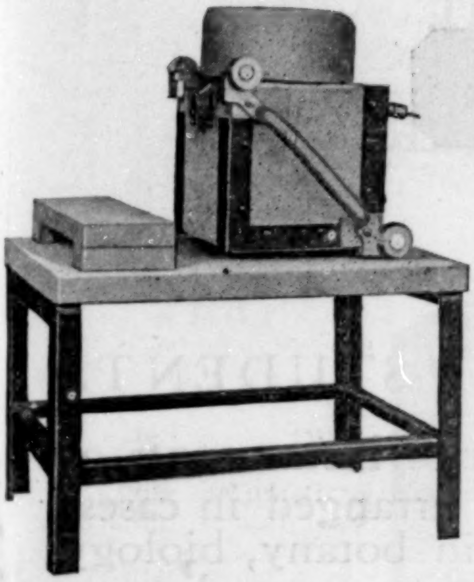

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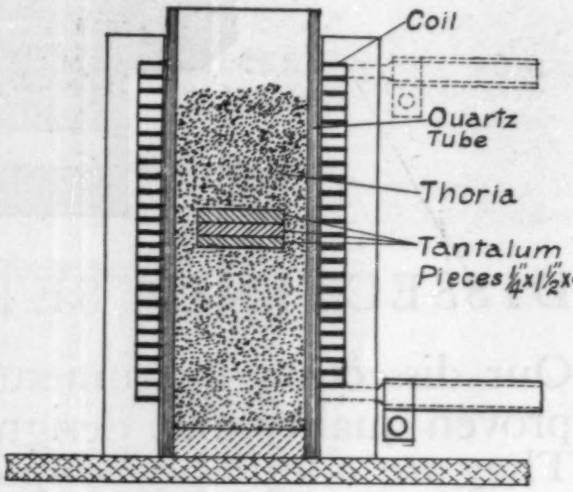
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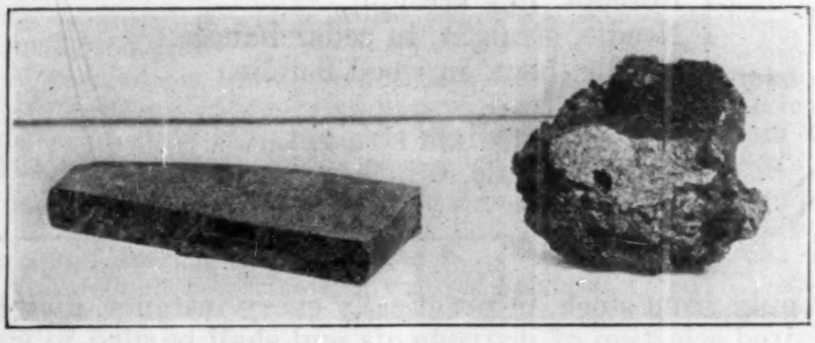

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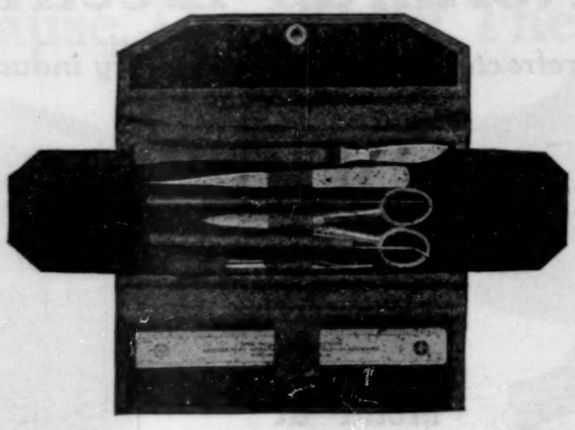

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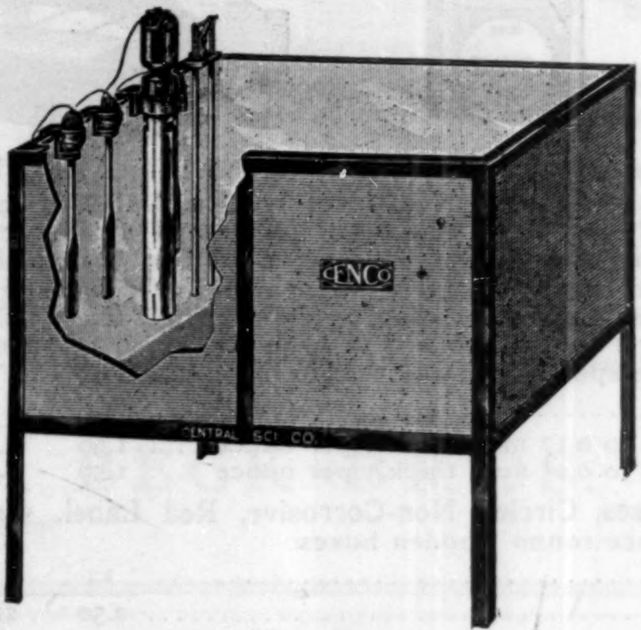

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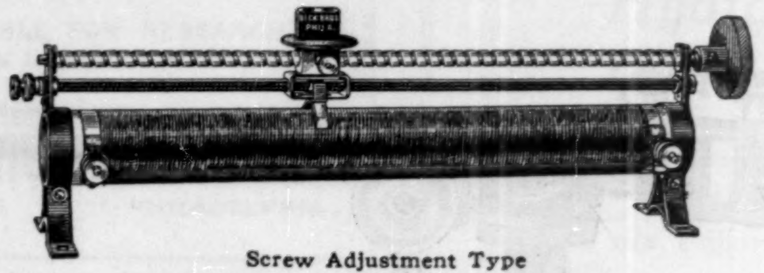

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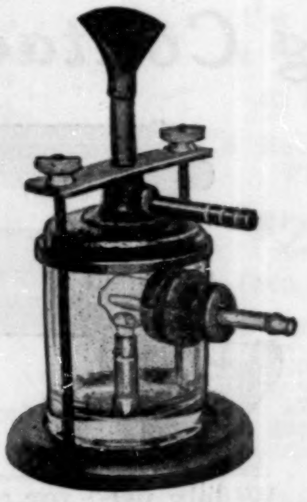

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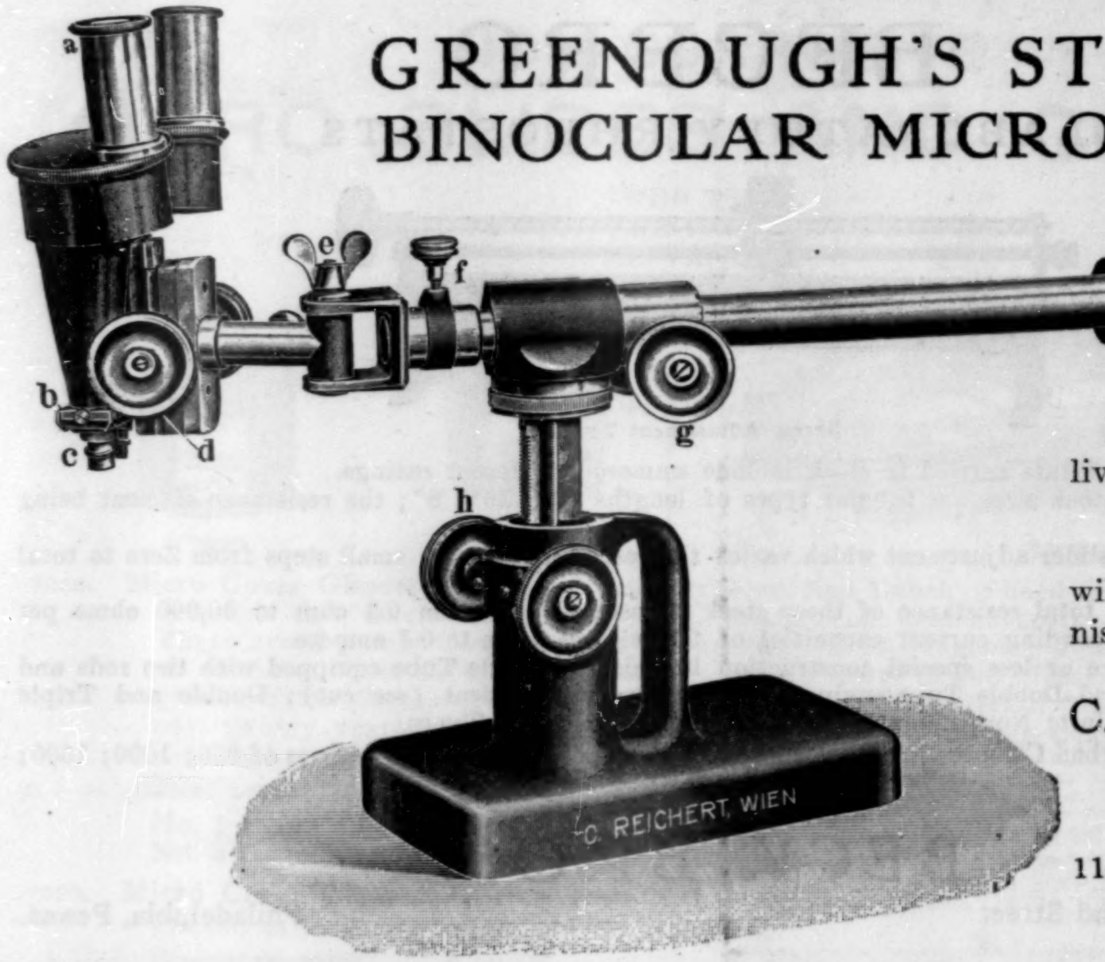

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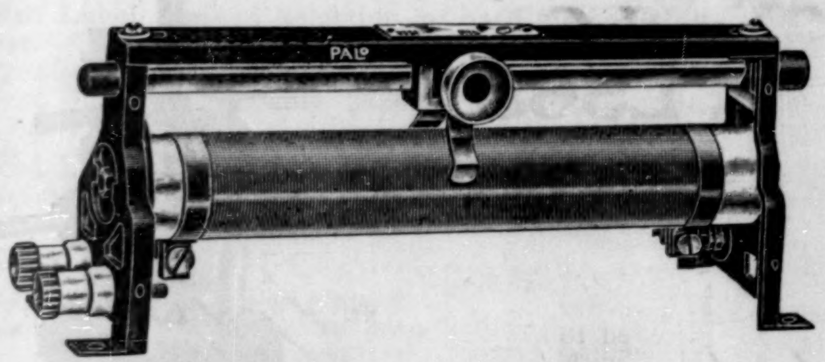

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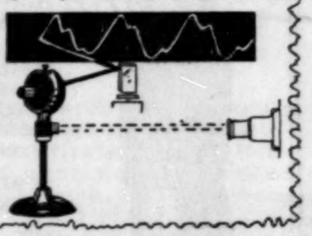

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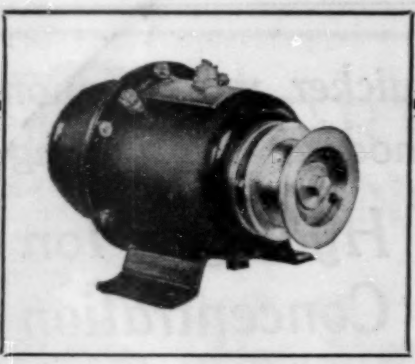

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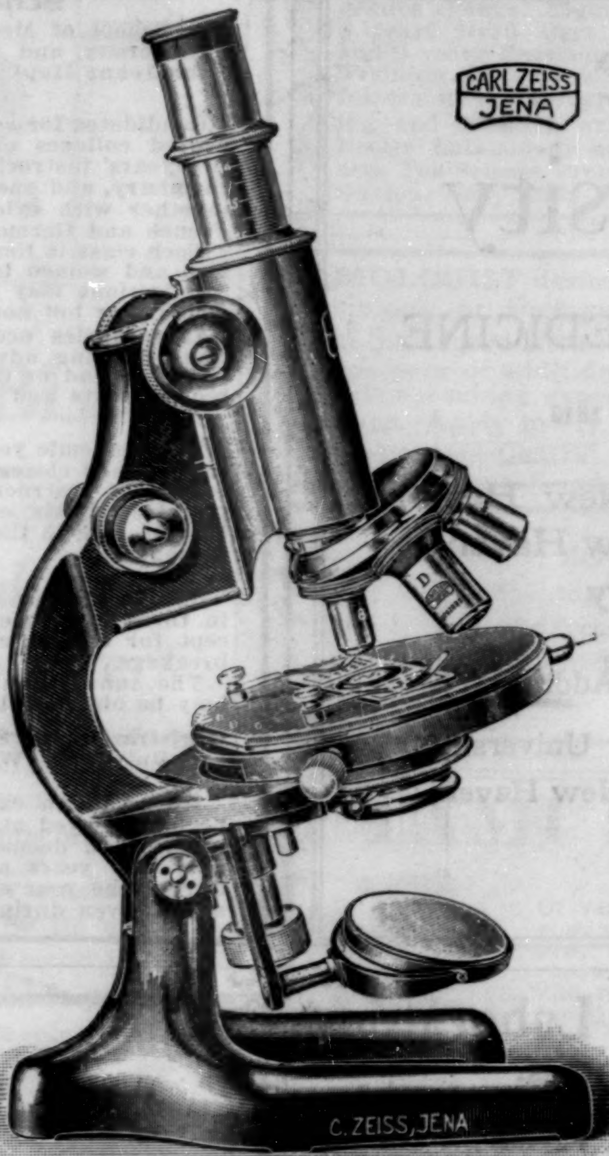

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